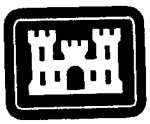
Access Study to all Pertinent Parts of Dam Projects During High Reservoir Conditions

Upper Connecticut Basin New Hampshire and Vermont

JULY 1992



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This report evaluates existing access routes to pertinent parts of completed Corps of Engineers dams in the Upper Connecticut River Basin during high reservoir conditions and makes recommendations for improved access when adequate access is not available. Seven dams in the Upper Connecticut River Basin were investigated; Union Village Dam, North Hartland Lake, North Springfield Lake, Ball Mountain Lake, Townshend Lake, Surry Mountain Lake, and Otter Brook Lake. Each project was studied to evaluate the adequacy of the existing emergency access routes to the embankment crests, downstream toes of the dam and dike embankments, the emergency spillways, and outlet works. Two general conditions were evaluated that would require emergency access: (1) uncontrolled seepage at the downstream toe of a dam or dike embankment and (2) failure of rock cut slopes causing blockage of spillway or outlet works channels. Condition number one was considered to be more severe because it would pose a structural threat. Access to some features was found to be inadequate. However, in some cases, existing access, although not meeting design criteria, was judged to be acceptable at this time.

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ACCESS STUDY TO ALL PERTINENT PARTS OF DAM PROJECTS DURING HIGH RESERVOIR CONDITIONS UPPER CONNECTICUT RIVER BASIN NEW HAMPSHIRE AND VERMONT

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

JULY 1992

ACCESS STUDY TO ALL PERTINENT PARTS OF
DAM PROJECT DURING HIGH RESERVOIR CONDITIONS

UPPER CONNECTICUT RIVER BASIN
NEW HAMPSHIRE AND VERMONT

Table of Contents

Subject		Page
1.	INTRODUCTION	1
	1.1 References	1
	1.2 Authority	1
	1.3 Purpose	1
	1.4 Scope	1
2.	GENERAL NOTES	2
3.	DESIGN CRITERIA	2
4.	CONCLUSIONS AND RECOMMENDATIONS	2
	4.1 General	2
	4.2 Union Village Dam	2
	4.3 North Hartland Lake	3
	4.4 North Springfield Lake	3
	4.5 Ball Mountain Lake	3
	4.6 Townshend Lake	4
	4.7 Surry Mountain Lake	4
	4.8 Otter Brook Lake	4
5.	SCHEDULES AND FINDING	4

List of Plates

Plate No.	Title
A-1	Union Village Dam - General Plan
A-2	Union Village Dam - Profiles and Sections
B-1	North Hartland Lake - General Plan
C-1	North Springfield Lake - General Plan
C-2	North Springfield Lake - Profiles and Sections
D-1	Ball Mountain Lake - Plan and Sections
E-1	Townshend Lake - General Plan
E-2	Townshend Lake - Profiles and Sections
F-1	Surry Mountain Lake - General Plan
F-2	Surry Mountain Lake - Profile and Sections
G-1	Otter Brook Lake - Plan and Sections

Appendices

A	Union Village Dam
B	North Hartland Lake
C	North Springfield Lake
D	Ball Mountain Lake
E	Townshend Lake
F	Surry Mountain Lake
G	Otter Brook Lake
H	Trip Report

1. INTRODUCTION

1.1 References.

a. ER 1130-2-419, Dam Operations Management Policy, dated 18 May 1978.

b. ER 1110-2-100, Periodic Inspection and Continuing Evaluation of Completed Civil Works Structures, dated 8 April 1988.

c. DAEN-ECE-B letter, subject: Trip Report - NED Office Visit and Damsite Inspections (22-25 October 1984) dated 5 November 1984. A copy is included in Appendix H.

1.2 Authority. It was recommended in reference 1.1c, paragraph 4d, that this study be initiated to review all of the Division Dam projects and to determine if adequate access is available to all pertinent parts of each dam project during high reservoir and emergency conditions.

1.3 Purpose. The purpose of this report is to evaluate existing access routes to pertinent parts of completed Corps of Engineers dams in the Upper Connecticut River Basin during high reservoir conditions and to make recommendations for improved access when adequate access is not available.

1.4 Scope. The following seven dam projects in the Upper Connecticut River Basin were investigated:

Project	Location
Union Village Dam	Thetford, VT
North Hartland Lake	Hartland and Hartford, VT
North Springfield Lake	Weathersfield and Springfield, VT
Ball Mountain Lake	Jamaica and Londonderry, VT
Townshend Lake	Townshend and Jamaica, VT
Surry Mountain Lake	Surry and Gilsum, NH
Otter Brook Lake	Keene, NH

Each project was studied to evaluate the adequacy of the existing emergency access routes to the embankment crests, downstream toes of the dam and dike embankments, the emergency spillways, and outlet works. Determinations of adequacy of existing access during high reservoir and emergency conditions were made. Recommendations for new access routes or improvements to existing access routes are provided where existing access was considered inadequate. In addition to having access to all pertinent features during high reservoir conditions, two general conditions were evaluated that would require emergency access: (1) uncontrolled seepage at the downstream toe of a dam or dike embankment and (2) failure of rock cut slopes causing blockage of spillway or outlet works channels. Of the two conditions, uncontrolled seepage at the downstream toe was considered to be the more severe as this would threaten the integrity of the dam while a channel blockage would only slow draw down efforts but in most cases would not pose a structural threat.

2. GENERAL NOTES

Sources of information used for this study include field notes, 35mm photographs taken during site visits conducted August 1990, aerial photographs, information obtained from project managers and park rangers, project plans and design memoranda, and embankment performance during past high reservoir pool conditions.

3. DESIGN CRITERIA

Adequate access routes are 12 foot minimum width gravel roads with at least 12 inches of compacted gravel fill. The roads shall not have grades steeper than 12.5 percent nor turning radii less than 50 feet. Vehicles expected to utilize access routes include ten cubic yard dump trucks, backhoes, bulldozers, and medium size truck mounted cranes. It is assumed that cranes with boom lengths from 100 to 130 feet and a minimum working reach of 60 feet can be readily obtained for emergency work.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 General. Existing emergency access to pertinent features of seven projects were evaluated. Access to some features was found to be inadequate. Proposed new access routes are summarized in Section 5 of this report and described in detail in the appendices to this report. In some cases, existing access, although not meeting design criteria, was judged to be acceptable at this time based on the location of the subject feature relative to the reservoir pool at spillway crest, the extent and condition of existing access, the likelihood of a condition developing which would require emergency access, and other considerations. Therefore, recommendations for new routes to some features have not been made although existing access does not meet the stated design criteria.

Normal maintenance procedures to insure adequate emergency access shall include the clearing and removal of all vegetation and obstructions within 15 feet of embankment tops and abutments as a means of access and to facilitate inspection during high pool conditions. Additionally, all routes providing access to pertinent features of the projects should be kept clear. The project manager should bring to the attention of the Chief, Design and Facilities Evaluation Branch, Geotechnical Engineering Division, any deterioration of an emergency access route which may render a pertinent feature of the project inaccessible during high pool conditions. The following recommendations for each project studied are made to improve emergency access. Details of recommended improvements to existing routes or recommended new routes are given in the respective appendices.

4.2 Union Village Dam. Access to the toes and outlet works at Union Village Dam should be improved. The grass surface along Access Road "H" should be replaced with gravel so heavy equipment could reach the downstream toe, outlet structure and outlet channel of the dam if the area softened during a high

pool or heavy rain storm. The gravel surface of Access Road "D" should be resurfaced with six inches of gravel and new gravel Access Road "E" should be constructed to provide easier access to the inlet channel and structure. A ramp at the west end and a ramp and stone berm extension at the east end of Access Road "F" should be considered to improve access to the upstream toe of the dam. It should be noted that there is a weight limit of eight tons for the covered bridge on Academy Road between West Road and Access Road "C". If use of Access Road "C" is necessary due to inundation of West Road during spillway discharge, equipment exceeding eight tons would have to travel west on Academy Road from Interstate 91 to Access Road "C".

4.3 North Hartland Lake. The crest and toe areas of North Hartland Dam can be easily reached by travelling on bituminous and gravel roads from Vermont State Route 5. It is recommended that Access Road "D" be constructed to improve access to the grass area at the downstream toe of the dam. Access to the discharge channel and downstream abutments of the dam is inadequate. Possible solutions to the inadequate access were considered but are beyond the scope of this study.

4.4 North Springfield Lake. Access to the main portion of North Springfield Dam is good, except to the outlet structure. Access to the toes at the North Branch of the dam are inadequate. Access Road "N" (a proposed gravel and rock fill road) and Access Road "O" (a proposed gravel road at grade) are recommended at the North Branch of the dam. Design of possible access routes to the outlet structure at the main portion of the dam are beyond the scope of this study. Improvements of the main portion of the dam to Access Road "G" (flattening for easier access to the outlet channel), Access Road "H" (flattening and gravel surfacing for easier access to the inlet structure and channel), Access Road "I" (gravel surfacing and resurfacing for easier access to the upstream toe and inlet structures), and Access Road "K" (gravel surfacing for easier access to the west downstream toe) and construction of new Access Road "F" (access to the upstream end of the inlet channel) should also be considered.

4.5 Ball Mountain Lake. It is not possible for heavy equipment to reach the crest, upstream and downstream toes, outlet works, and spillway channel (except for approximately a 100 foot reach adjacent to the turn around at the end of Access Road "E") at Ball Mountain Dam during spillway discharge conditions. It is recommended that Access Road "F" be upgraded as described in paragraph 4 of Appendix D so access to the downstream toe, outlet channel and outlet structure can be attained. Coordination with State of Vermont would be required to improve Access Road "F" because it passes through a State park. Two possible options to reach the crest of Ball Mountain Dam from the turn around at the end of Access Road "E" are discussed in paragraph 7 of Appendix D. The option to construct a road by cutting into the south slope of the spillway channel from the turn around to the weir and then spanning the channel with a short curved bridge appears to be less expensive and should be considered.

4.6 Townshend Lake. Access to the pertinent features of Townshend Dam is generally good. It does not appear that additional access roads are needed, however improvements to existing access roads are recommended for ease of use by heavy equipment. The slopes on Access Road "C" should be flattened and additional gravel should be placed on the reach which crosses the upstream toe of the dam and ends at the outlet structure and channel area. The three steep slopes in Access Road "D" should be flattened so heavy equipment can easily reach the downstream toe outlet channel and outlet structure of the dam during spillway discharge. Larger pipes should be placed under the section of Access Road "E" which crosses the end of the discharge channel to reduce wash-outs that occur near the existing pipes during heavy rain storms.

4.7 Surry Mountain Lake. Access to the crest of Surry Mountain Dam can be accomplished by travelling on State and local bituminous concrete roads and is considered good. Access to the toes and outlet works of the dam was considered fair at the August 1990 site visit. Project staff installed new culverts, improved drainage channels, removed brush and added gravel along Access Road "B" during the summer of 1991 which greatly improved access to Access Road "C". The grass section of Access Road "C" which runs along the downstream toe of the dam should be replaced by an approximately seven foot high stone berm so that it can be used during spillway discharge to reach the downstream toe, outlet channel and outlet structure. Clearing and additional gravel surface material are needed along Access Road "E" to improve existing access to the inlet structure and channel. Access Road "F" (a new stone berm road lower portion) and gravel road at grade (upper portion) should be considered to reach the upstream toe of Surry Mountain Dam. Clearing and additional gravel surface material along Access Road "D" would be needed in conjunction with Access Road "F".

4.8 Otter Brook Lake. Access to all the pertinent features except the upstream toe of Otter Brook Dam is very good. It is recommended that new Access Road "E" (a new stone berm extension of Access Road "D") be considered along the upstream toe of the dam.

5. SCHEDULES AND FUNDING

A summary of proposed improvements to and construction of access features, recommended priorities and estimated costs is listed below for dams in the Upper Connecticut River Basin. Recommendations assigned a high priority should be budgeted and implemented in the next two budget years (FY-95, FY-96), those items assigned a moderate priority should be budgeted and implemented within the next three years, and those with a low priority should be budgeted and implemented within the next five years. Funds will be requested under normal operation and maintenance budgets for each project.

Summary of Recommendations and Costs

Project	Access Feature	Recommended Priority	Estimated Cost ($)
Union Village Dam	Access Road "D" (improvement)	Moderate	7,000
Union Village Dam	Access Road "E" (new construction)	Moderate	5,000
Union Village Dam	Access Road "F" (improvement)	Low	69,000
Union Village Dam	Access Road "H" (improvement)	High	21,000
North Hartland Lake	Access Road "D" (new construction)	High	8,000
North Springfield Lake	Access Road "F" (new construction)	Moderate	17,000
North Springfield Lake	Access Road "G" (improvement)	Moderate	17,000
North Springfield Lake	Access Road "H" (improvement)	Moderate	22,000
North Springfield Lake	Access Road "I" (improvement)	Moderate	24,000
North Springfield Lake	Access Road "K" (improvement)	Moderate	11,000
North Springfield Lake	Access Road "O" (new construction)	Moderate	9,000
North Springfield Lake	Access Road "N" (new construction)	High	33,000
Ball Mountain Lake	Access Road "A"- Option A (improvement)	Moderate	2,200,000
Ball Mountain Lake	Access Road "A"- Option B (improvement)	Moderate	1,700,000

Ball Mountain Lake	Access Road "F" (improvement)	High	200,000
Townshend Lake	Access Road "C" (improvement)	Moderate	21,000
Townshend Lake	Access Road "D" (improvement)	High	24,000
Townshend Lake	Access Road "E" (improvement)	High	17,000
Surry Mountain Lake	Access Road "C" (improvement)	High	160,000
Surry Mountain Lake	Access Road "D" (improvement)	Low	5,000
Surry Mountain Lake	Access Road "E" (improvement)	Moderate	5,000
Surry Mountain Lake	Access Road "F" (new construction)	Low	170,000
Otter Brook Lake	Access Road "E" (new construction)	Low	65,000

APPENDIX A

UNION VILLAGE DAM

APPENDIX A
UNION VILLAGE DAM

TABLE OF CONTENTS

Paragraph No.	Subject	Page No.
	A. Pertinent Data	
1.	Pertinent Data	A-1
	B. Access to Downstream Toe	
2.	Existing Access	A-2
3.	Adequacy of Access	A-2
4.	Recommended Improvements	A-2
	C. Access to Crest of Dam	
5.	Existing Access	A-2
6.	Adequacy of Access	A-3
7.	Recommended Improvements	A-3
	D. Access to Outlet Works	
8.	Existing Access	A-3
9.	Adequacy of Access	A-3
10.	Recommended Improvements	A-3
	E. Access to Spillway - Channel and Weir	
11.	Existing Access	A-3
12.	Adequacy of Access	A-4
13.	Recommended Improvements	A-4
	F. Cost Estimates	
14.	Cost Estimates	A-4

LIST OF PLATES

Plate No.	Title
A-1	Union Village Dam - General Plan
A-2	Union Village Dam - Profiles and Sections

APPENDIX A
UNION VILLAGE DAM

A PERTINENT DATA

1. Pertinent Data.

LOCATION: The dam is on the Ompompanoosuc River, four miles above the river's junction with the Connecticut River. It is one-fourth mile north of Union Village, Vermont, and 11 miles north of White River Junction, Vermont. The project lies within the town of Thetford, Orange County, Vermont.

CONSTRUCTION PERIOD: March 1947 to June 1950.

PURPOSE: The reservoir is operated as a unit of the comprehensive plan for flood control in the Connecticut River Basin.

RESERVOIR:

Drainage Area: 126 Square Miles

Operating Levels:

Pool	Elevation (ft, NGVD)	Area (acres)	Cumulative Capacity (acre-ft)
Invert	419.0	---	---
Winter	440.0	50	400
Flood Control (Spillway Crest)	564.0	740	38,400

DAM:

Type:	Rolled earth and rock fill
Maximum Height (ft):	170
Length (ft):	1,100
Top Elevation (ft, NGVD):	584.0

SPILLWAY:

Location:	Right abutment
Type:	Chute spillway w/ogee weir
Crest Length (ft):	388
Crest Elevation (ft, NGVD):	564.0
Maximum Discharge Capacity (cfs)	84,900

OUTLET WORKS:

Type:	Circular conduit
Size:	13'- diameter
Length (ft):	1,167
Gates:	(2) 7'-6" x 12'-0" broome

B. ACCESS TO DOWNSTREAM TOE OF DAM

2. Existing Access. The downstream toe of Union Village Dam is a grassy area that has flat to moderately steep slopes. The toe area was once a portion of the Ompompanoosuc River channel. The area is reached by traveling down a gravel ramp (approximately 20 percent slope) which slopes down to the north from West Road. The ramp is located approximately 50 feet west of Avery Brook and approximately 1,000 feet south of the dam. West Road is a 20 foot wide bituminous concrete road. It generally extends northwesterly from Vermont Route 132, approximately two miles to the south of the dam, and ends at the parking area on the west end of the dam crest. A portion of West Road between the ramp and Academy Road to the south would be inundated during spillway conditions. One would have to travel west on Academy Road from Interstate 91 to Access Road "C", up Access Road "C" to Access Road "A" (crest road) and across the crest road to West Road to reach the ramp during spillway discharge. A covered bridge on Academy Road has an eight ton limit which would limit the size of equipment which could cross it, if one wanted to reach Access "C" by traveling east on Academy Road from Vermont Route 132 during spillway discharge. Academy Road and Access Road "A" have bituminous concrete surfaces while Access Road "C" has a gravel surface.

3. Adequacy of Access. The grassy area in the immediate vicinity of the downstream toe does not meet design criteria. Heavy equipment would probably have difficulty operating in the downstream toe area during spillway discharge. Only equipment under eight tons in weight could reach the toe area once spillway discharge conditions occurred because of the load limitations on the Academy Road covered bridge.

4. Recommended Improvements. Access Road "H" as shown on Plates A-1 and A-2 should be improved in the downstream toe area. Flattening of the gravel ramp at West Road and a steep slope on the east side of the old Ompompanoosuc River channel would be required to improve Access Road "H". The improvement would also provide better access to the outlet channel and structure. Upgrading the covered bridge on Academy Road to allow a higher load limit is beyond the scope of this study.

C. ACCESS TO CREST OF DAM

5. Existing Access. Access Road "A" is a 20 foot wide bituminous concrete road which crosses the crest of Union Village Dam. West Road and Access Road "C" meet the west and east ends of Access Road "A". West Road and Access Road "C" are discussed in paragraph 2.

The upper portion of the upstream slope can be reached by cranes stationed on Access Road "A". The lower portion of the upstream slope is difficult to reach because the upstream toe of Union Village Dam is a marshy area with heavy vegetation. One must traverse an approximately 20 percent slope from Vermont State Route 132 to the spillway approach channel bottom,

travel along the spillway approach channel, and traverse another approximately 20 percent slope to reach the marshy area. The access route is shown as Access Road "F" on Plate A-1.

6. Adequacy of Access. Access to the crest of Union Village Dam is adequate. Presently, access to the lower portion of the upstream toe of the dam is inadequate during normal pool conditions.

7. Recommended Improvements. Access Road "F" should be improved, as shown in Plates A-1 and A-2, so that the upstream toe and slope of Union Village Dam can be reached during normal pool conditions. Flattening two steep slopes and placement of a significant amount of rock fill will be required to improve Access Road "F".

D. ACCESS TO OUTLET WORKS

8. Existing Access. The intake channel and structure can be reached by traveling down Access Road "D" from Access Road "B". Only the south 100 feet of the intake channel can be reached from Access Road "D". Access Road "D" is a narrow road with a gravel surface. A large amount of grass and vegetation were noted on Access Road "D". Access Road "B" is an 18 foot wide bituminous concrete road which slopes upward from Access Road "D" to the crest of the dam where it intersects Access Road "A" (dam crest road) and Access Road "C" (a gravel road to Academy Road and Vermont State Route 132).

The outlet channel and structure can be reached by crossing the downstream toe area of the dam. Access to it is similar to the downstream toe area of the dam which was discussed in paragraph 2.

9. Adequacy of Access. The narrowness and vegetation make it difficult for heavy equipment to use Access Road "D", although a 35 ton crane was recently used on Access Road "D" to clear debris from the intake structure area. In addition, Access Road "D" does not service the north 100 feet of the inlet channel. The grass surface and moderately steep slopes of the downstream toe area would make it difficult for the heavy equipment to reach the outlet channel and structure.

10. Recommended Improvements. Access Road "D" should be cleared, grubbed, widened and surfaced with six additional inches of gravel to make it easier to use the road. Access "E" should be constructed as shown in Plates A-1 and A-2 to provide access to the north 100 feet of the inlet channel. Access Road "H" should be improved as discussed in paragraph 4 to provide better access to the outlet channel and structure.

E. ACCESS TO SPILLWAY - CHANNEL AND WEIR

11. Existing Access. The top of the east bank of the spillway channel can be reached during spillway discharge by traveling west 50 to 100 feet over grass areas from either West Road or the parking area at the crest of dam. During low water, the bottom of the spillway channel can also be reached by

descending from Route 132 (Access Road "F") or crossing a grass field (Access Road "G") behind the office building. A small amount of gravel might be needed to bridge soft spots along Access Roads "F" and "G" if they were used immediately after a high water event.

12. Adequacy of Access. Access to the spillway channel is adequate. The approach channel has relatively flat side slopes (1 vertical on 3 horizontal) so the chance of slope failure which would significantly block it is unlikely. The discharge channel is relatively wide (170 feet minimum) so a slope failure along its steep west slope probably would not significantly block it. Furthermore, it can be easily reached from the crest parking area or West Road.

13. Recommended Improvements. Improvements to existing access to the spillway weir and channel are not recommended at this time.

F. COST ESTIMATES

14. Cost Estimates.

Improvement to Access Road "D"

Item	Qty	Unit	Unit Price ($)	Cost ($)
Mob-demob	1	Job	LS	2,000
Stripping	1	Job	LS	1,000
Gravel Fill	200	CY	1500	3,000
Subtotal				6,000
Contingency 20%				1,200
TOTAL				7,200
SAY				$7,000

Construction of Access Road "E"

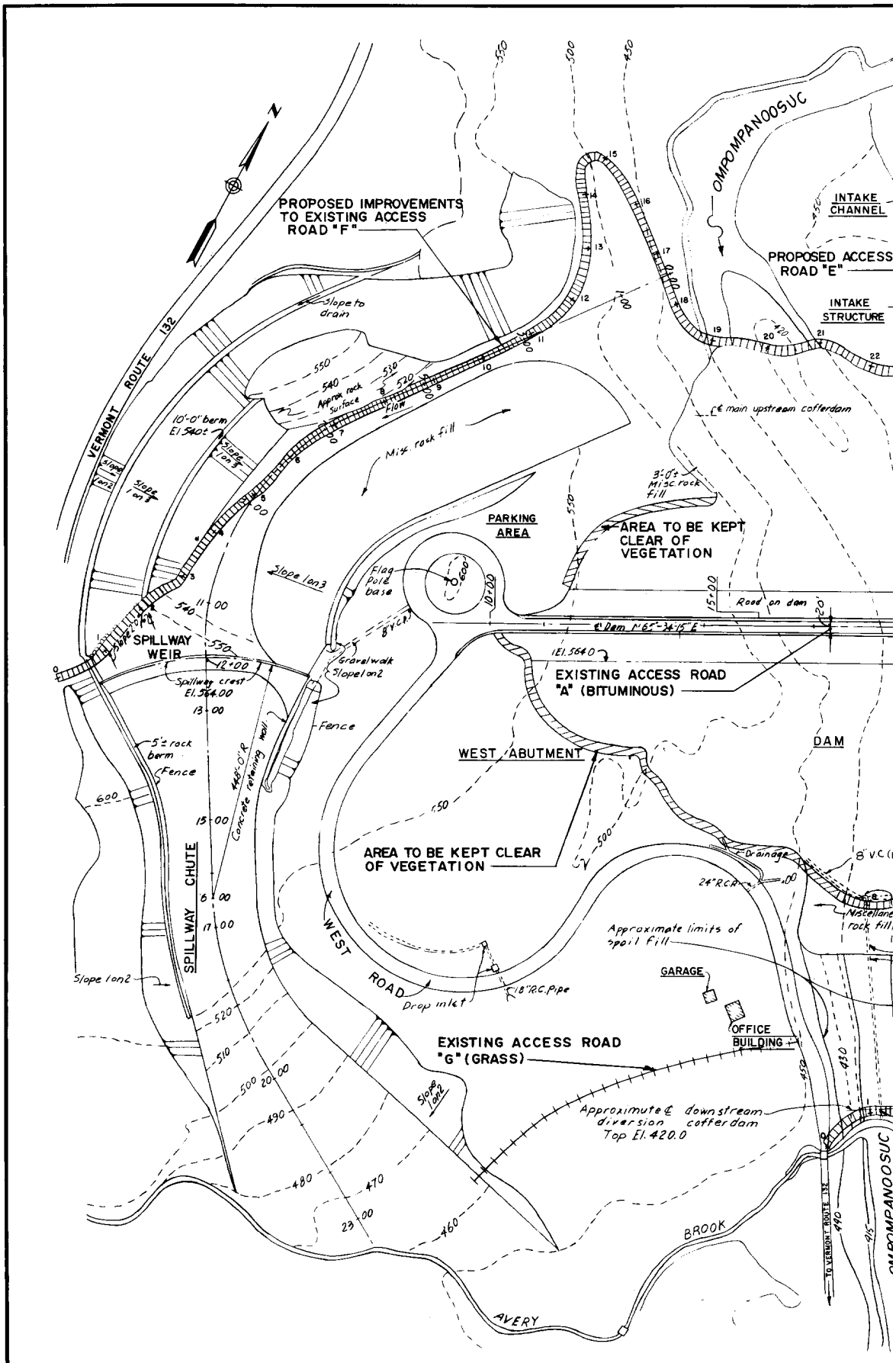
Item	Qty	Unit	Unit Price ($)	Cost ($)
Mob-demob	1	Job	LS	2,000
Stripping	1	Job	LS	1,000
Random Fill	60	CY	8.00	480
Gravel Fill	50	CY	15.00	750
Subtotal				4,230
Contingency 20%				846
TOTAL				5,076
SAY				$5,000

Improvement to Access Road "F"

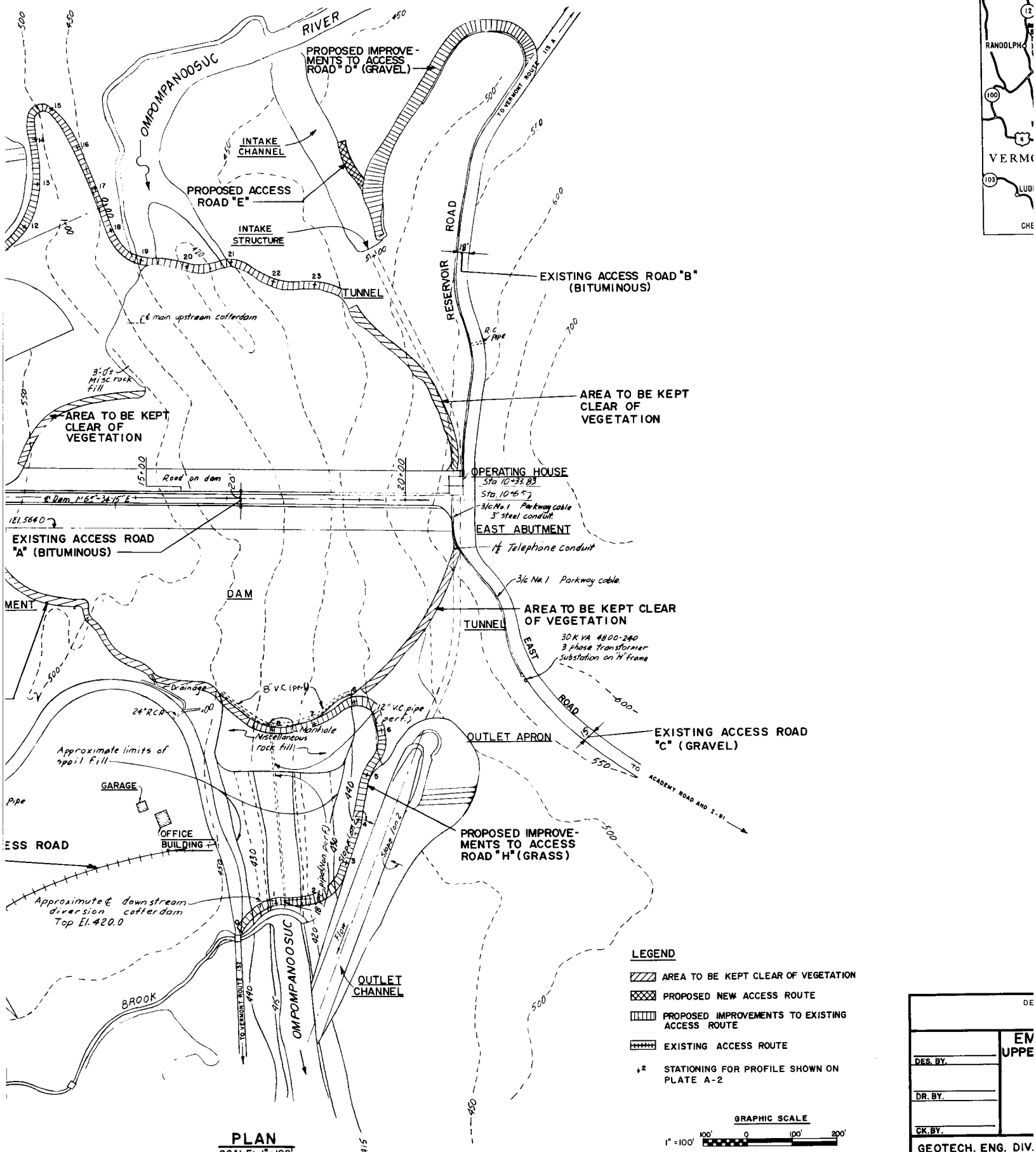
Item	Qty	Unit	Unit Price ($)	Cost ($)
Mob-demob	1	Job	LS	2,000
Clearing	1	Job	LS	2,000
Excavation	800	CY	6.00	4,800
Random Fill	1,000	CY	8.00	8,000
Gravel Fill	800	CY	15.00	12,000
Rock Fill	700	CY	40.00	28,000
Crushed Stone	30	CY	25.00	750
Subtotal				57,550
Contingency 20%				11,510
TOTAL				69,060
SAY				$69,000

Improvement to Access Road "H"

Item	Qty	Unit	Unit Price ($)	Cost ($)
Mob-demob	1	Job	LS	2,000
Stripping	1	Job	LS	2,000
Excavation	400	CY	6.00	2,400
Random Fill	300	CY	8.00	2,400
Gravel Fill	500	CY	15.00	7,500
24" CMP	30	LF	30.00	900
Subtotal				17,200
Contingency 20%				3,440
TOTAL				20,640
SAY				$21,000



PLAN
SCALE: 1" = 100'

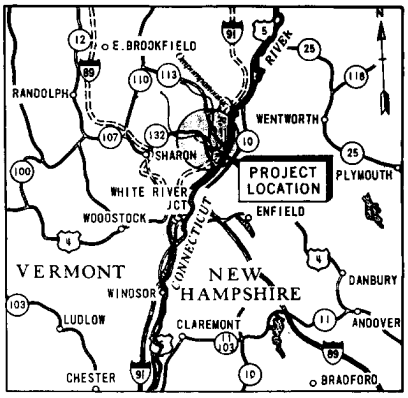


PLAN
SCALE: 1" = 100'

DES. BY.
DR. BY.
CK. BY.

GEOTECH. ENG. DIV.

PLATE A-1



VICINITY MAP

SCALE IN MILES

10 0 10 20

EXISTING ACCESS ROAD "B" (BITUMINOUS)

700

AREA TO BE KEPT CLEAR OF VEGETATION

ISE

cable

ENT

e conduit

Parkway cable

A TO BE KEPT CLEAR
EGETATION

30 KVA 4800-240
3 phase transformer
Substation on 'H' frame

600

ROAD

EXISTING ACCESS ROAD "C" (GRAVEL)

550

TO ACADEMY ROAD AND I-91

500

VE-
ESS
S)

LEGEND

- AREA TO BE KEPT CLEAR OF VEGETATION
- PROPOSED NEW ACCESS ROUTE
- PROPOSED IMPROVEMENTS TO EXISTING ACCESS ROUTE
- EXISTING ACCESS ROUTE
- +2 STATIONING FOR PROFILE SHOWN ON PLATE A-2

GRAPHIC SCALE

1" = 100' 100' 0 100' 200'

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CORPS OF ENGINEERS
WALTHAM, MASS.

EMERGENCY ACCESS STUDY
UPPER CONNECTICUT RIVER BASIN
UNION VILLAGE DAM
GENERAL PLAN

DES. BY.

DR. BY.

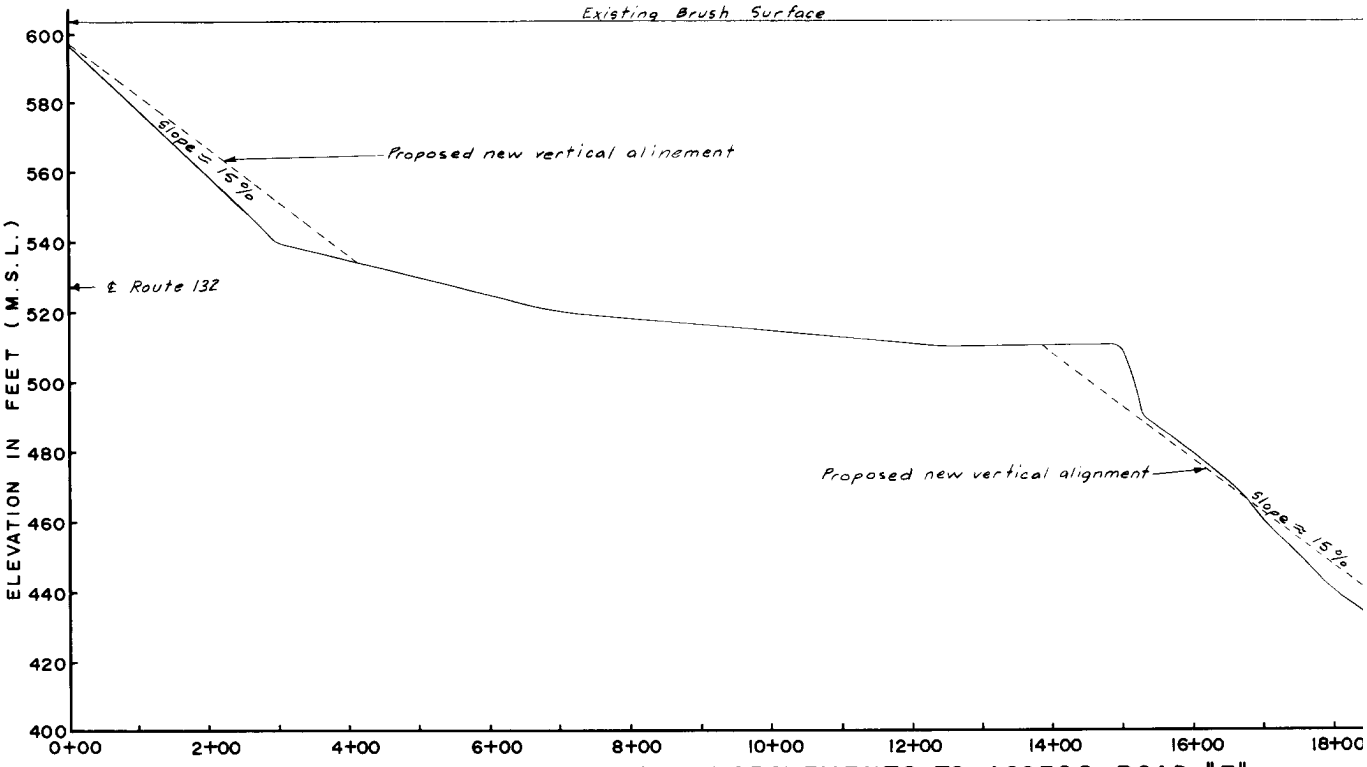
CK. BY.

GEOTECH. ENG. DIV.

PLATE A-1

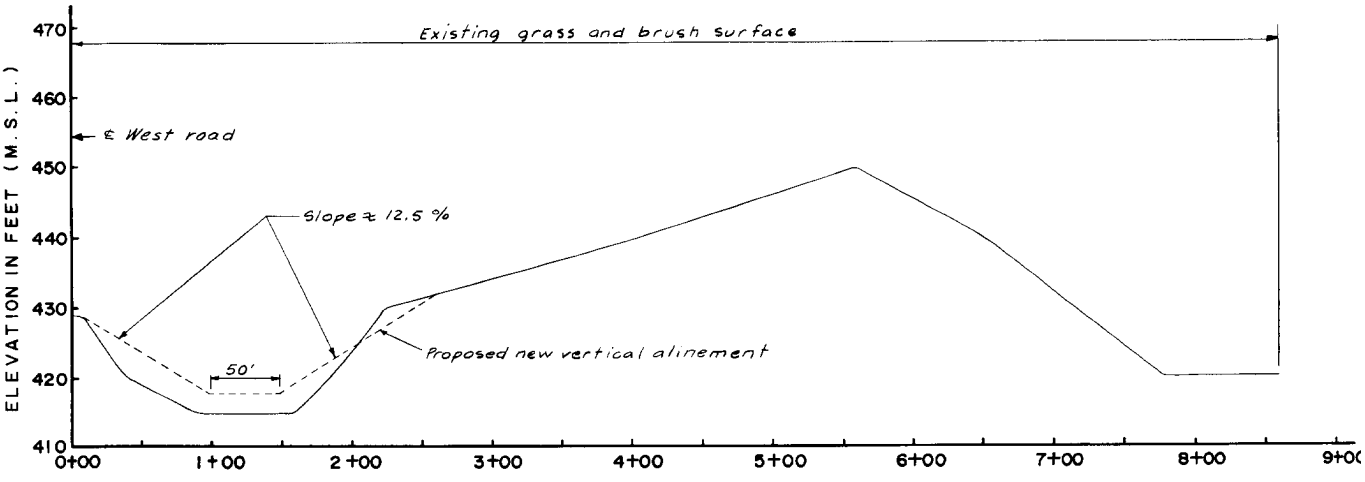
SCALE: AS SHOWN

DATE: AUG. 1990



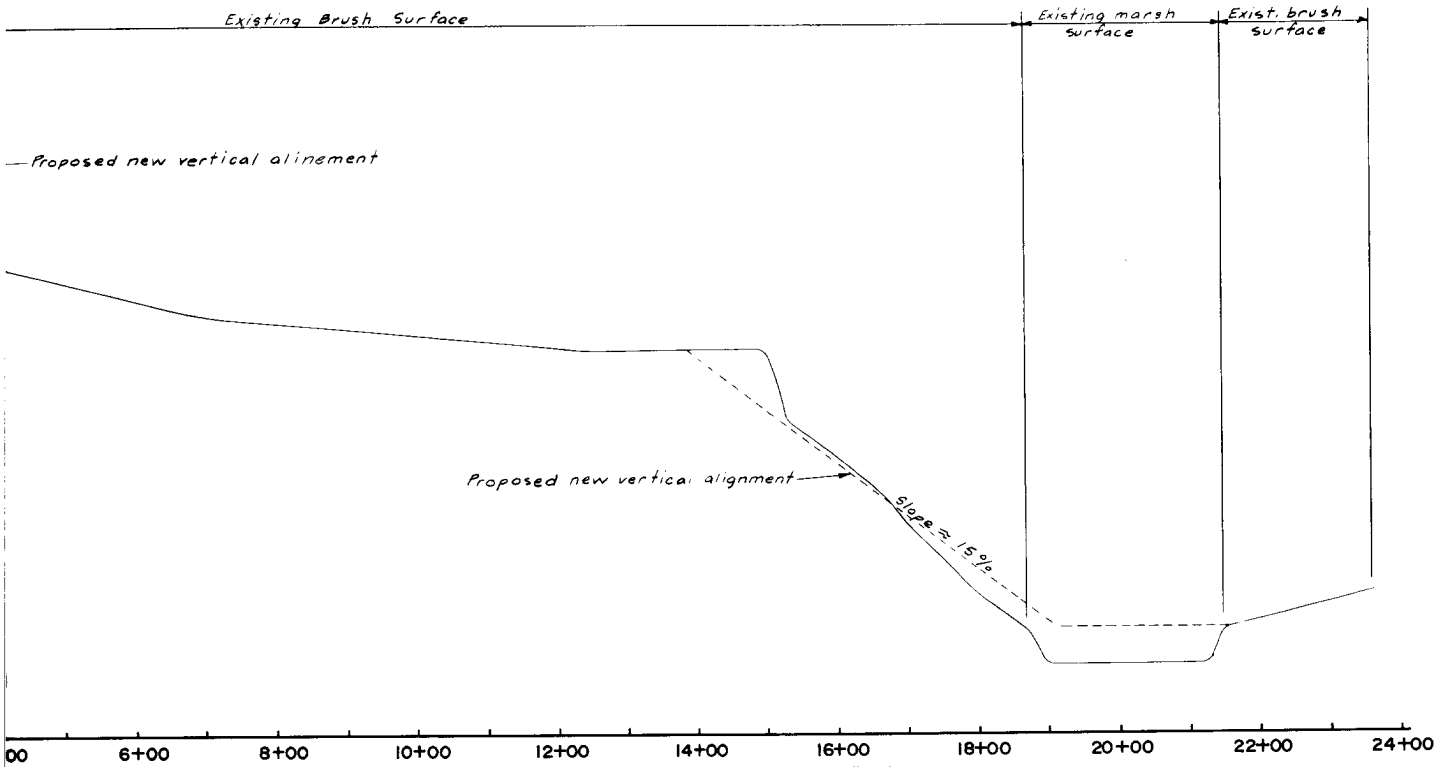
PROPOSED IMPROVEMENTS TO ACCESS ROAD "F"

SCALES: HORZ: 1" = 100'
VERT: 1" = 20'



PROPOSED IMPROVEMENT TO ACCESS ROAD "H"

SCALES: HORZ: 1" = 50'
VERT: 1" = 10'



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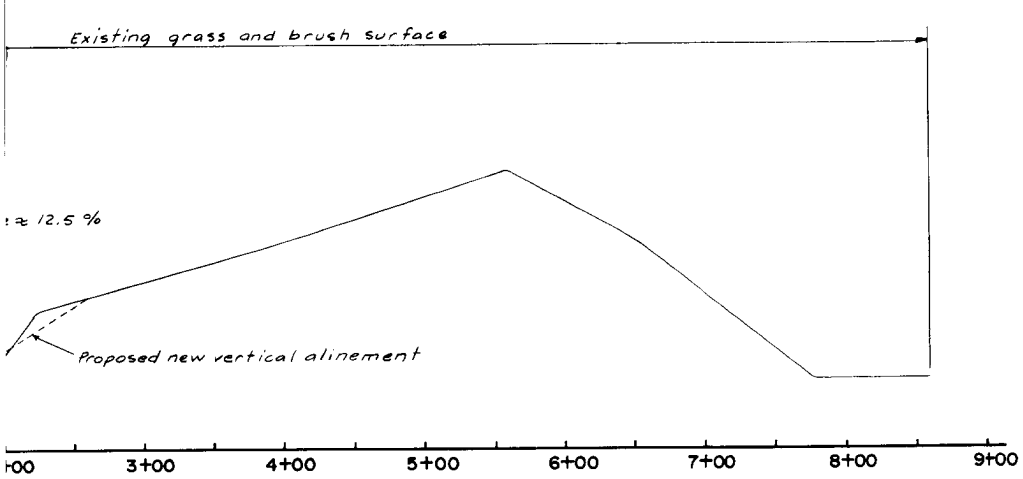
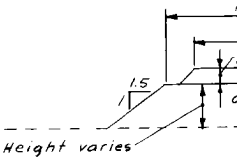
VERT: 1" = 20'



PROPOSED IMPROVEMENT TO ACCESS ROAD "H"

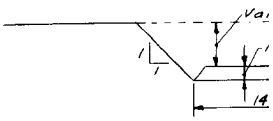
SCALES: HORZ: 1" = 50'
VERT: 1" = 10'

TYPICA



TYPICAL FILL SECTION FO

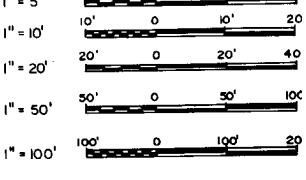
S

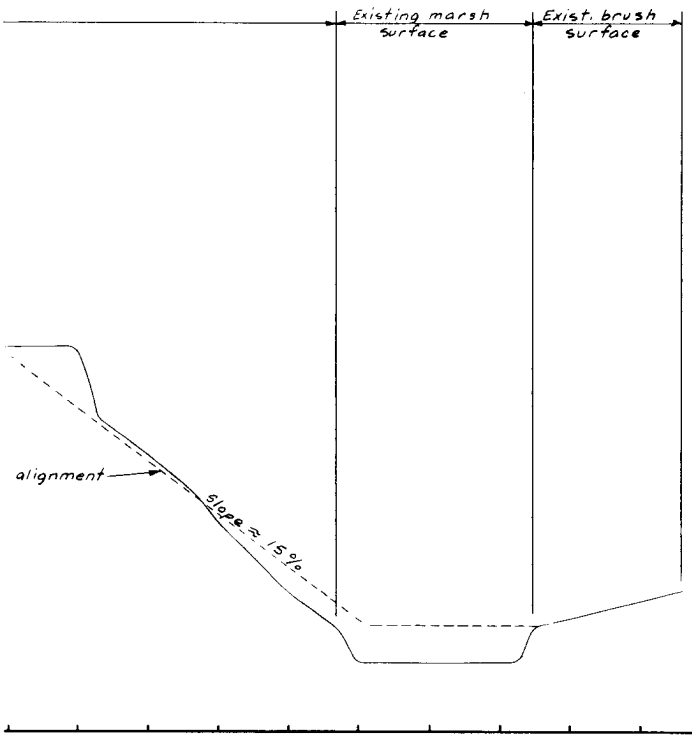


TYPICAL CUT SECTION FOR

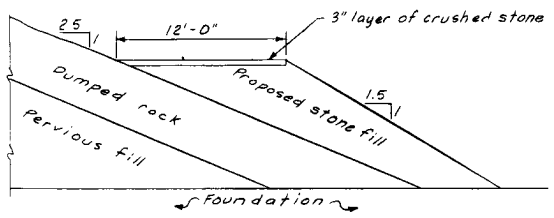
S

GRAPHIC SCALES



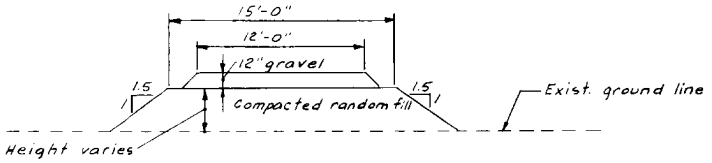


:SS ROAD "F"



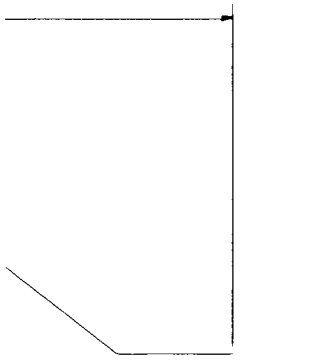
TYPICAL FILL SECTION FOR PROPOSED DAM ACCESS ROAD "F"

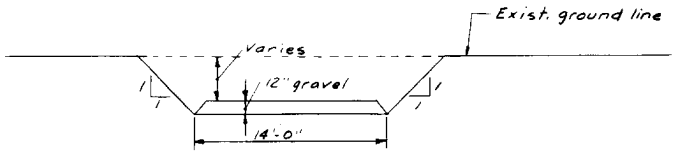
SCALE: 1" = 5'



TYPICAL FILL SECTION FOR PROPOSED DAM ACCESS ROADS "E" AND "H"

SCALE: 1" = 5'





TYPICAL CUT SECTION FOR PROPOSED DAM ACCESS ROADS "F" AND "H"

SCALE: 1" = 5'

+00
8+00
9+00

GRAPHIC SCALES

1" = 5'	5'	0	5'	10'
1" = 10'	10'	0	10'	20'
1" = 20'	20'	0	20'	40'
1" = 50'	50'	0	50'	100'
1" = 100'	100'	0	100'	200'

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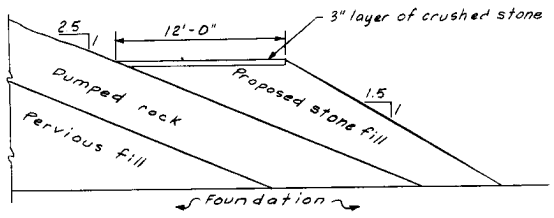
WALTHAM, MASS.

EMERGENCY ACCESS STUDY
UPPER CONNECTICUT RIVER BASIN
UNION VILLAGE DAM
PROFILES AND SECTIONS

DES. BY:
DR. BY:
CK. BY:

GEOTECH. ENG. DIV.
PLATE A-2

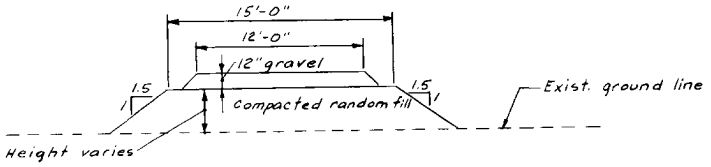
SCALE: AS SHOWN
DATE: AUG. 1990



TYPICAL FILL SECTION FOR PROPOSED DAM ACCESS ROAD "F"

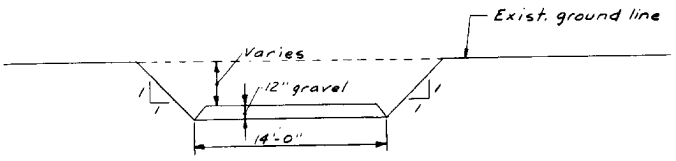
SCALE: 1" = 5'

24+00



PICAL FILL SECTION FOR PROPOSED DAM ACCESS ROADS "E" AND "H"

SCALE: 1" = 5'



PICAL CUT SECTION FOR PROPOSED DAM ACCESS ROADS "F" AND "H"

SCALE: 1" = 5'

GRAPHIC SCALES

1" = 5' 5' 0 5' 10'

1" = 10' 10' 0 10' 20'

1" = 20' 20' 0 20' 40'

1" = 50' 50' 0 50' 100'

1" = 100' 100' 0 100' 200'

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WALTHAM, MASS.

DES. BY:

DR. BY:

CK. BY:

EMERGENCY ACCESS STUDY
UPPER CONNECTICUT RIVER BASIN
UNION VILLAGE DAM
PROFILES AND SECTIONS

GEOTECH. ENG. DIV.
PLATE A-2

SCALE: AS SHOWN
DATE: AUG. 1990

APPENDIX B

NORTH HARTLAND LAKE

APPENDIX B
NORTH HARTLAND LAKE

TABLE OF CONTENTS

Paragraph No.	Subject	Page No.
	A. Pertinent Data	
1.	Pertinent Data	B-1
	B. Access to Downstream Toe	
2.	Existing Access	B-2
3.	Adequacy of Access	B-2
4.	Recommended Improvements	B-2
	C. Access to Crest of Dam	
5.	Existing Access	B-3
6.	Adequacy of Access	B-3
7.	Recommended Improvements	B-3
	D. Access to Outlet Works	
8.	Existing Access	B-3
9.	Adequacy of Access	B-3
10.	Recommended Improvements	B-3
	E. Access to Spillway - Channel and Weir	
11.	Existing Access	B-3
12.	Adequacy of Access	B-4
13.	Recommended Improvements	B-4
	F. Access to Dike - Toes and Crest	
14.	Existing Access	B-4
15.	Adequacy of Access	B-4
16.	Recommended Improvements	B-4
	G. Cost Estimates	
17.	Cost Estimates	B-4

LIST OF PLATES

Plate No.	Title
B-1	North Hartland Lake - General Plan

APPENDIX B

NORTH HARTLAND LAKE

A. PERTINENT DATA

1. Pertinent Data.

LOCATION: The damsite is on the Ottaquechee River, 1.5 miles above the river's junction with the Connecticut River and one mile northwest of North Hartland, Vermont. The project lies within the towns of Hartland and Hartford in Windsor County, Vermont.

CONSTRUCTION PERIOD: June 1958 to June 1961

PURPOSE: The reservoir is operated as a unit of a coordinated system of reservoirs for flood control in the Connecticut River Basin. Although not specifically authorized, recreational facilities are also provided. Non-Federal hydropower facilities have been constructed immediately downstream of the project's outlet works by Vermont Electric Generation and Transmission Cooperative.

RESERVOIR:

Drainage Area: 220 Square Miles

Operating Levels:

Pool	Elevation (ft, NGVD)	Area (acres)	Cumulative Capacity (acre-ft)
Invert	390.0	0	0
Permanent	410.0	80	700
Recreation	425.0	215	3,050
Flood Control (Spillway Crest)	546.5	1,100	74,150

DAM:

Type:	Rolled earth and rock fill
Maximum Height (ft):	185
Length (ft):	1,640
Top Elevation (ft. NGVD):	572.0

DIKE:

Type:	Rolled earth and rockfill
Length (ft):	2,110
Maximum Height (ft):	52
Top Elevation (ft, NGVD):	572.0-574.0

SPILLWAY:

Location:	Left abutment
Type:	L-shaped side channel spillway with ogee weir
Crest Length (ft):	465
Crest Elevation (ft, NGVD):	546.5
Maximum Discharge Capacity (cfs)	160,900

OUTLET WORKS:	DAM	DIKE
Type:	Circular	Circular
Size:	12'-0" diameter	36" diameter
Length (ft):	743 (to hydro station) 1213 (including hydro station)	476
Gates:	(3) 5'-8" width x 10' height vertical slide	(1) 3'x3' vertical sluice
Discharge at Spillway Crest (cfs):	169,000	
Stilling Basin:	none	

B. ACCESS TO DOWNSTREAM TOE OF DAM

2. Existing Access. The downstream toe area is an approximately 200 foot wide flat grassy area with some low lying brush. The downstream toe is flanked by steep abutments which can only be reached by light weight equipment. The downstream toe area of North Hartland Dam can be reached by using Access Road "C". Access Road "C" is a gravel road which extends westerly from Vermont state Route 5 to the dam. It can be used up until spillway discharge conditions occur. Heavy equipment used Access Road "C" during the past few years to construct the hydro unit at the dam.

3. Adequacy of Access. Access to the downstream toe of North Hartland Dam is inadequate. Heavy equipment may bog down in the grassy downstream toe area and cannot traverse the steep adjacent abutment slopes. Spillway discharges would prevent access to the area by blocking Access Road "C". Providing access to the downstream toe during spillway discharge is beyond the scope of this study.

4. Recommended Improvements. Access Road "D" should be constructed to allow heavy equipment to reach the downstream toe of North Hartland Dam without bogging down. Access Road "D" construction would require removal of existing vegetation and soft material along the proposed road alinement and then placement of 12 inches of gravel. Vegetation should be periodically removed from the dam abutment interfaces to allow for inspection of the interfaces and light weight equipment to traverse the interfaces.

C. ACCESS TO CREST OF DAM

5. Existing Access. Access Road "A" services the crest of North Hartland Dam. Access Road "A" extends to the north across the dike and the dam from Clay Hill Road. Clay Hill Road has a bituminous concrete surface and extends to the west from Vermont State Route 5. Access Road "A" is a 22 foot wide bituminous concrete road up to a point approximately 20 feet south of the service bridge and then changes to a 23 foot wide gravel road. It is in excellent condition.

Access to the upstream toe of the dam can be obtained from Access Road "B". Access Road "B" is an approximately 15 foot wide gravel road which originates approximately 1,000 feet south of the office building. It runs generally to the north along the upstream toe of the dam to the intake tower structure and then across the upstream slope of dam to the west end of the spillway channel. The portion of the road which crosses the upstream slope of the dam is supported by rock fill.

6. Adequacy of Access. Access to the crest and upstream toe of North Hartland Dam is considered adequate.

7. Recommended Improvements. Improvements to existing or construction of new access to the crest and upstream toe of North Hartland Dam are not recommended.

D. ACCESS TO OUTLET WORKS

8. Existing Access. The inlet channel and base of the intake structure at North Hartland Dam can be reached from Access Road "B" during low water conditions. A small amount of gravel might be needed to bridge soft spots, if heavy equipment is to travel on the grass area south of the inlet channel soon after a high water event. The top of the intake channel can be reached during high water events from the service bridge which ties into Access Road "A". The outlet channel and structure can be reached from gravel Access Road "C" which extends north from Vermont State Route 5. Spillway discharge would prevent the use of Access Road "C".

9. Adequacy of Access. Access to the outlet works at North Hartland Dam is considered adequate. Possible modes of access to the outlet channel and structure during spillway discharge conditions are beyond the scope of this study.

10. Recommended Improvements. No improvements are recommended to improve access to the outlet works at North Hartland Dam.

E. ACCESS TO SPILLWAY - CHANNEL AND WEIR

11. Existing Access. The spillway channel can be reached from Access Roads "A", "B", and "C". Access Road "B" services the spillway weir and the west end of the spillway approach channel areas from the upstream slope of the dam.

It can be used during low water conditions only. Access Road "A" services a short central segment (approximately 50 feet) of the spillway channel from the crest of the dam. It can be used during spillway discharge. Access Road "C" allows easy access of heavy equipment along the downstream floor of the spillway until spillway discharge occurs.

12. Adequacy of Access. Access to the spillway weir and channel is inadequate for spillway discharge conditions. The steep sides and rugged terrain along the channel make access extremely difficult and expensive to obtain.

13. Recommended Improvements. Improvements to the existing access to the spillway channel and weir at North Hartland Dam are not recommended. Construction of new access roads to the spillway channel and weir are beyond the scope of this study.

F. ACCESS TO DIKE - TOES AND CREST

14. Existing Access. Access Road "A", which was discussed in paragraph 5, crosses the crest of the dike. Access Roads "E" (gravel surface) and "F" (grass surface) extend along the upstream and downstream slopes of the dike from Clay Hill Road to Access Road "A". They are grass roads in good condition.

15. Adequacy of Access. Access to the North Hartland Dike is considered adequate.

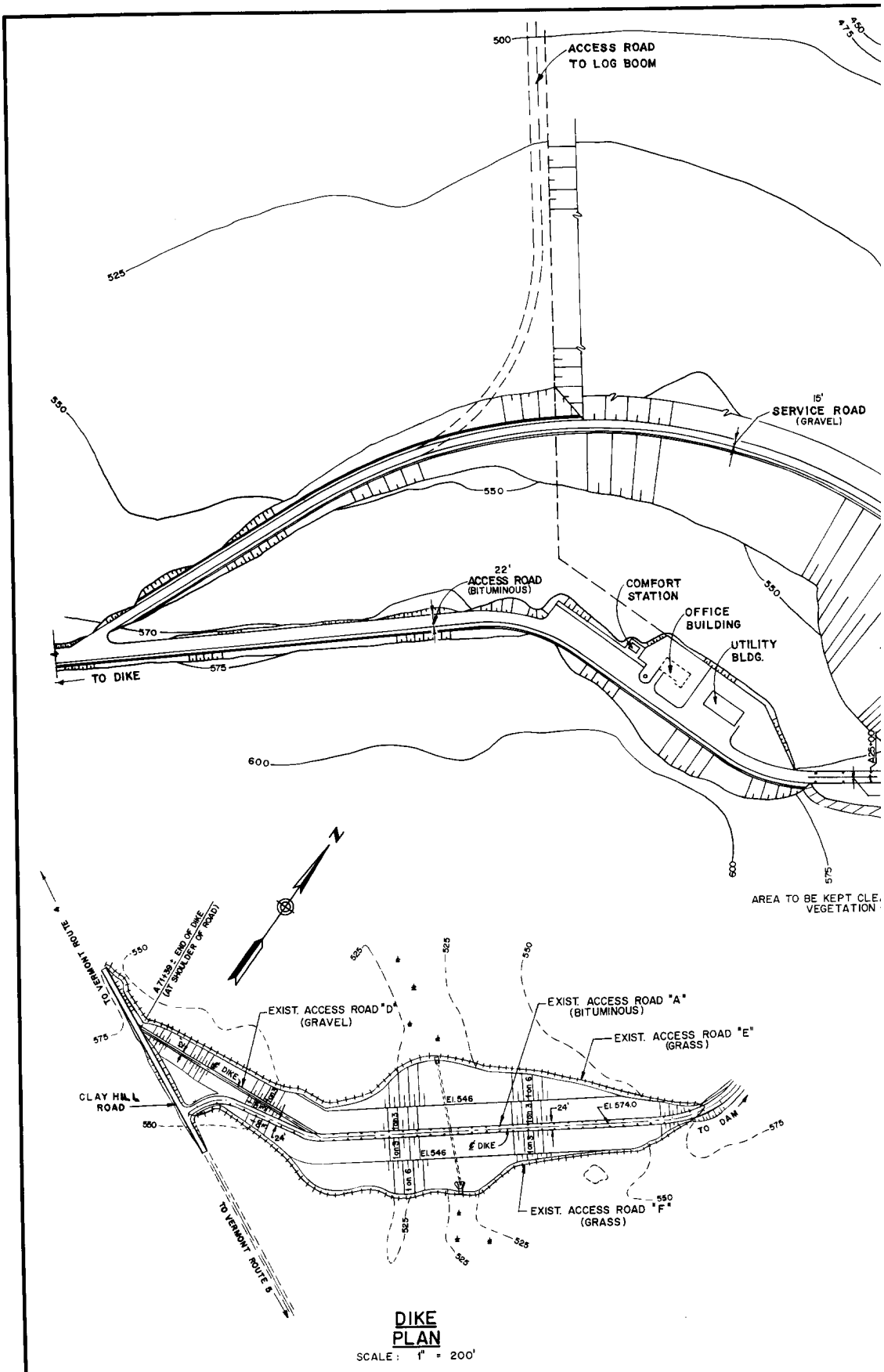
16. Recommended Improvements. No improvements to existing access roads or new access roads are recommended at the North Hartland Dike. A small amount of gravel may be needed to bridge soft spots along toe Access Roads "E" and "F" if they are used during or immediately after high water events.

G. COST ESTIMATE

17. Cost Estimate.

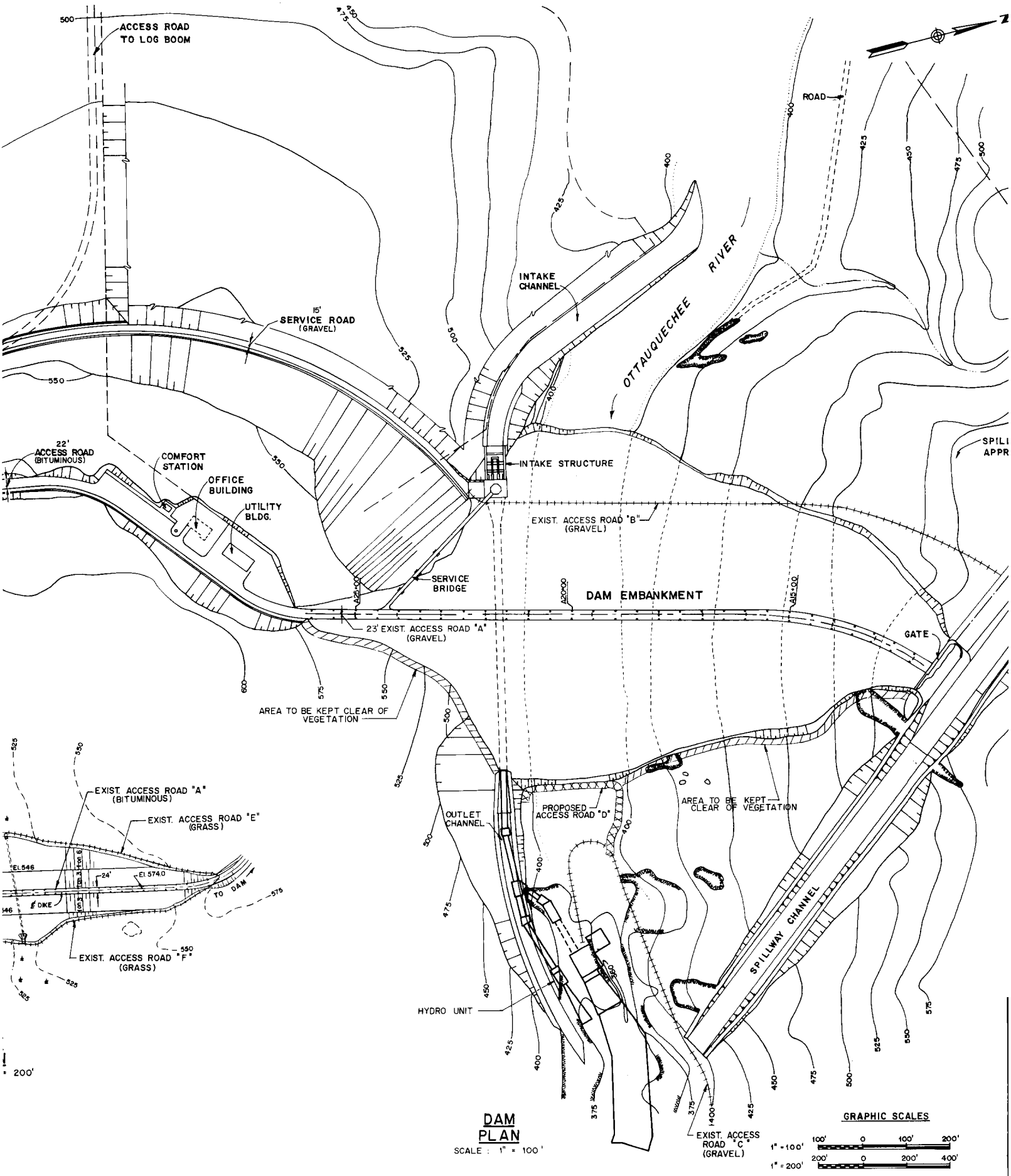
Construction of Access Road "D"

Item	Qty	Unit	Unit Price ($)	Cost ($)
Mob-demob	1	Job	LS	2,000
Clearing and Stripping	1	Job	LS	500
Excavation	110	CY	6.00	660
Gravel Fill	220	CY	15.00	3,300
Subtotal				6,460
Contingency 20%				1,292
TOTAL				7,752
SAY				$8,000



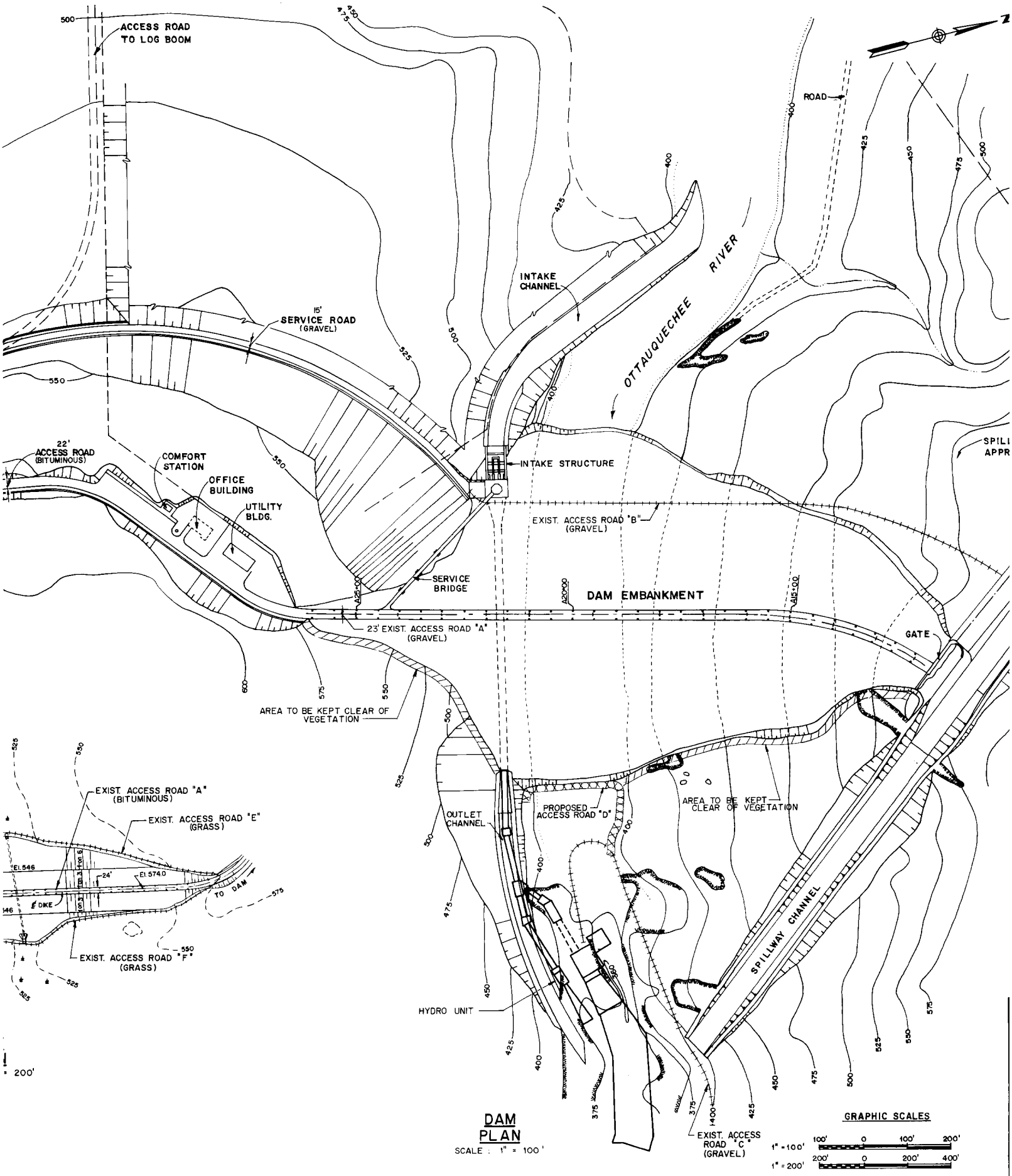
DIKE
PLAN

SCALE: 1" = 200'



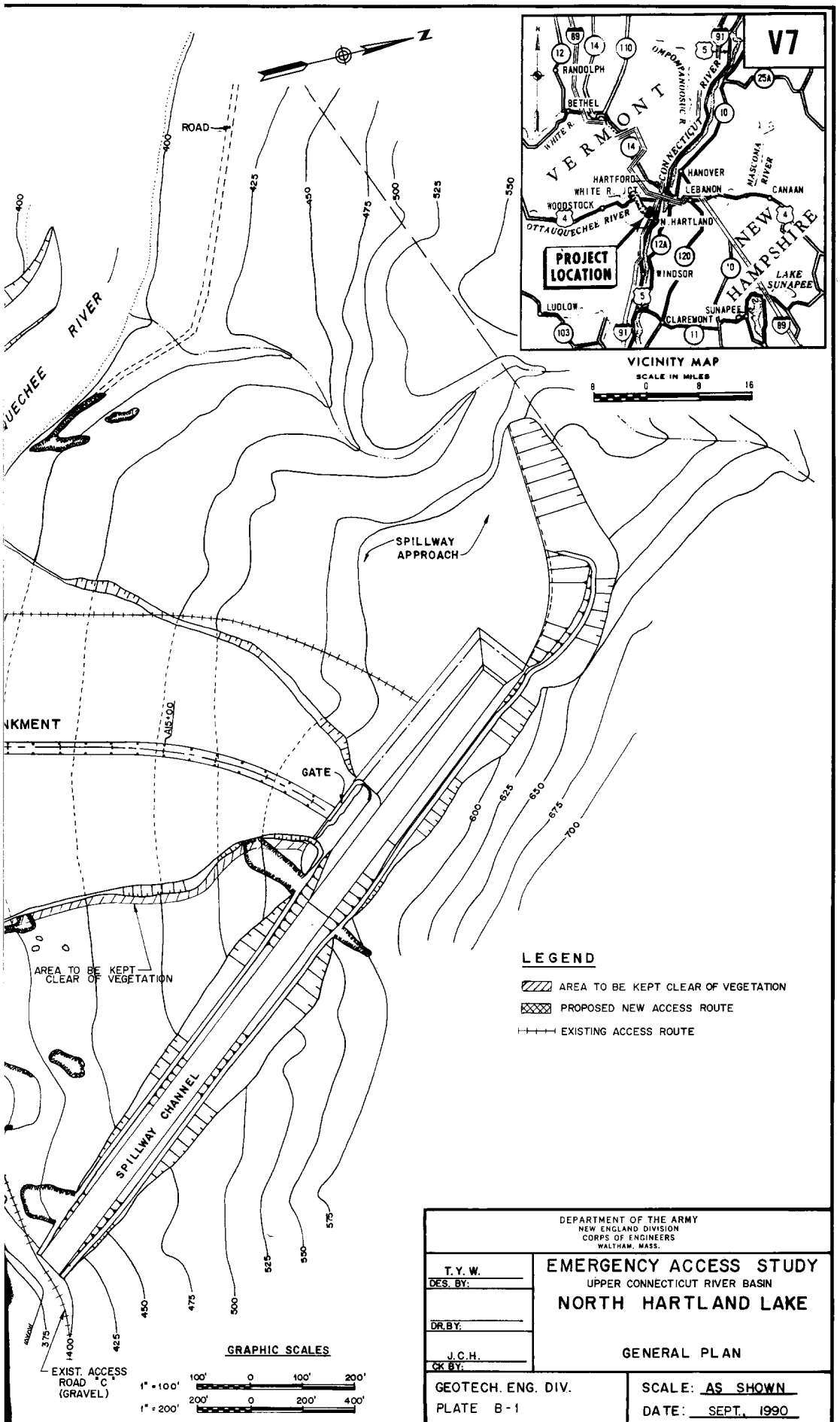
DAM PLAN

SCALE : 1" = 100'



DAM PLAN

SCALE : 1" = 100'



VICINITY MAP
SCALE IN MILES
8 0 8 16

LEGEND

- AREA TO BE KEPT CLEAR OF VEGETATION
- PROPOSED NEW ACCESS ROUTE
- EXISTING ACCESS ROUTE

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

EMERGENCY ACCESS STUDY

UPPER CONNECTICUT RIVER BASIN

NORTH HARTLAND LAKE

GENERAL PLAN

T.Y.W. DES. BY:	
DR. BY:	
J.C.H. CK BY:	
GEOTECH. ENG. DIV. PLATE B-1	SCALE: AS SHOWN DATE: SEPT. 1990

APPENDIX C

NORTH SPRINGFIELD LAKE

APPENDIX C
NORTH SPRINGFIELD LAKE

TABLE OF CONTENTS

Paragraph No.	Subject	Page No.
	A. Pertinent Data	
1.	Pertinent Data	C-1
	B. Access to Downstream Toe	
2.	Existing Access	C-2
3.	Adequacy of Access	C-2
4.	Recommended Improvements	C-2
	C. Access to Crest of Dam	
5.	Existing Access	C-2
6.	Adequacy of Access	C-3
7.	Recommended Improvements	C-3
	D. Access to Outlet Works	
8.	Existing Access	C-3
9.	Adequacy of Access	C-3
10.	Recommended Improvements	C-4
	E. Access to Spillway - Channel and Weir	
11.	Existing Access	C-4
12.	Adequacy of Access	C-4
13.	Recommended Improvements	C-4
	F. Access to North Branch Dam - Toes and Crest	
14.	Existing Access	C-4
15.	Adequacy of Access	C-5
16.	Recommended Improvements	C-5
	G. Cost Estimates	
17.	Cost Estimates	C-5

LIST OF PLATES

Plate No.	Title
C-1	North Springfield Lake - General Plan
C-2	North Springfield Lake - Profiles and Sections

APPENDIX C

NORTH SPRINGFIELD LAKE

A. PERTINENT DATA

1. Pertinent Data.

LOCATION: The dam is in the town of Springfield, Vermont on the Black River, 8.7 miles above the river's junction with the Connecticut River, and three miles northwest of Springfield, Vermont. The project lies within the towns of Weathersfield and Springfield, Windsor County, Vermont.

CONSTRUCTION PERIOD: August 1939 to October 1941

PURPOSE: The reservoir is operated as a unit of a coordinated system of reservoirs for flood control in the Connecticut River Basin. Although not specifically authorized, recreational facilities are also provided.

RESERVOIR:

Drainage Area: 158 Square Miles

Operating Levels:

Pool	Elevation (ft, NGVD)	Area (acres)	Cumulative Capacity (acre-ft)
Invert	452.0	0	0
Permanent	467.0	100	500
Recreation			
(Black River)	475.0	290	2,000
(North Branch)	502.0	65	1,100
Flood Control (Spillway Crest)	545.5	1,200	51,100

DAM:	MAIN DAM	NORTH BRANCH
Type:	Rolled earth and Rock Fill	Rolled Earth and Rock Fill
Maximum Height (ft):	120	75
Length (ft):	2,940	900
Top Elevation (ft, NGVD):	570	552

SPILLWAY:		
Location:	Left Abutment	Crest
Type:	Conventional side channel w/ogee weir	Broad crested
Crest Length (ft):	384.0	200
Crest Elevation (ft, NGVD)	545.5	550

Maximum Discharge Capacity (cfs):	117,200	1,600

OUTLET WORKS:	MAIN DAM	NORTH BRANCH
Type:	Horseshoe conduit	Circular corrugated metal
Size:	12'-9" diameter	8' diameter
Length (ft):	659	300
Gates:	(3) 5'-12" slide	
Discharge at Spillway Crest (cfs):	11,900	
Stilling Basin:	None	

B. ACCESS TO DOWNSTREAM TOE OF DAM

2. Existing Access. Four roads service the downstream toe area of North Springfield Dam. Access Road "B" runs parallel to the downstream toe along the east side of the dam. It is a gravel road which was designed for and has been used by tractor trailers. Access Road "K" is a grass road which runs parallel to the downstream toe along the west side of the dam. Access Roads "C" and "D" are gravel roads which branch off Access Road "B". They service the seepage control weir, channel, and the downstream right abutment remedial walls and blanket.

3. Adequacy of Access. The access to the downstream toe of North Springfield Dam is adequate except for Access Road "K" which has a grass surface. It appears Access Road "K" might soften during high water conditions. Then it would become difficult to operate heavy equipment on it.

4. Recommended Improvements. It is recommended that Access Road "K" be cleared, grubbed and surfaced with 12 inches of gravel to meet design criteria.

C. ACCESS TO CREST OF DAM

5. Existing Access. Access Road "A" is a bituminous concrete road which crosses the crest of the main dam except for the west 650 feet. The bituminous concrete surface is typically 20 feet wide except where it widens at the service bridge (approximately 50 feet) and where it narrows at the spillway bridge (approximately 12 feet). The east end of Access road "A" intersects Reservoir Road. Reservoir Road is a bituminous concrete road which extends southerly to Vermont State Route 106 and Springfield, Vermont and extends northerly to Vermont Route 106 and Woodstock, Vermont. The west end of Access Road "A" intersects Vermont State 106. Access Road "P" (a 30 foot wide gravel road) branches off of Access Road "A" and crosses the west 650 feet of the main dam. It ends at the west end of the main dam.

The upstream toe and slope of North Springfield Dam can be reached by using Access Roads "I", "J", and "L". Access Road "I" extends northerly and then westerly from Access Road "A" to the spillway approach channel area. It passes through a wooded area, a grassy area and then crosses the upstream slope of the dam. It is a grass and gravel road which varies in width from 10 to 30 feet. Areas of Access Road "I" becomes soft after periods of extensive rain. Access Roads "J" and "L" are grass roads that extend along the west upstream slope of the dam. They can be used until the pool elevation reaches approximately elevation 540 feet NGVD. The area that Access Road "J" services could be reached from a crane situated on Access Road "A".

6. Adequacy of Access. Access to the crest of North Springfield Dam is adequate. Access to the upstream toe of the dam along Access Road "I" needs to be improved to allow heavy equipment to use the road after periods of heavy rain and high water events.

7. Recommended Improvements. Access Road "I" should be upgraded to allow heavy equipment to operate on it immediately after high water events. It should be extended to meet Access Road "H". The grass on the road (approximately thirty percent of the area) should be removed and grubbed. Soft materials under the grass or along the gravel portions of the road should be removed 12 inches of gravel shall be placed on former grass portions of the road, and six inches of gravel shall be placed on the existing gravel portions of the road. A small amount of gravel may be needed to use Access Roads "J" and "L" after heavy rain and high water events.

D. ACCESS TO OUTLET WORKS

8. Existing Access. The inlet channel and structure can be reached by using Access Road "H" during low water conditions. The inlet structure can be reached during high and low water conditions from the service bridge. Access Road "H" has a grass surface from the utility building parking area to a point approximately 600 feet west where it changes to gravel surface and turns sharply to the south. It runs along the inlet channel to the inlet structure a distance of approximately 400 feet after the sharp turn to the south. The grass portion of Access Road "H" has extremely steep slopes (some greater than 20 percent) while the gravel portion is relatively flat. The service bridge has a 12 foot wide concrete road surface.

The outlet channel and structure are very difficult to reach during both low and high water conditions. Stone slopes completely surround the outlet channel and structure. Only light weight equipment can be lowered from Access Roads "A" and "B" to the outlet channel and structure area.

9. Adequacy of Access. Access to the outlet works at North Springfield Dam is inadequate. The grass surface and steep slopes of Access Road "H" to the inlet channel and structure do not meet the design criteria. Only lightweight equipment can reach the outlet structure and channel under very difficult conditions.

10. Recommended Improvements. Access Road "H" should be flattened and surfaced with gravel as shown on Plate C-2. A new Access Road "F" should be constructed to service the upstream end of the inlet channel where debris accumulates frequently. Possible means of reaching the outlet channel and structure were considered but are judged to be beyond the scope of this study.

E. ACCESS TO SPILLWAY - CHANNEL AND WEIR

11. Existing Access. The spillway approach channel is a wide (approximately 400 feet) slightly vegetated area that gradually slopes down from the weir to the inlet channel. The weir and spillway approach channel can be reached during low water only from either Access Road "H" or Access Road "I". Access Roads "H" and "I" are discussed in paragraphs 8 and 5.

The spillway discharge channel is approximately 2,000 feet long. Typically the base of the channel is less than 50 feet wide and the channel side slopes are more than 50 feet high. The side slopes are near vertical rock cuts upstream of the spillway bridge and one vertical on 3.5 horizontal stone faced slopes downstream of the spillway bridge. Reservoir Road, the spillway bridge and the utility building parking area can be used to access the spillway channel upstream of the spillway bridge during spillway discharge. A small amount of grading and gravel would be required to move equipment in the area between Reservoir Road and the top of the spillway side slopes. The central portion of the spillway channel can be reached from Access road "E". Access Road "E" is a crushed stone surface road which runs roughly parallel and 50 to 100 feet east of the spillway channel. Access Road "E" can be reached from Reservoir Road by using Access Road "G". Access Road "G" is a grass and gravel road which has a relatively short but steep slope (the grade exceeds 30 percent for 30 feet). The downstream portion of the spillway channel can be reached from Access Road "B". Access Road "B" is a gravel surface road with grades up to 15 percent in the vicinity of the spillway channel.

12. Adequacy of Access. Access Roads "G"", "H", and "I" provide partial access to the spillway channel but do not entirely meet design criteria. Access Roads "B" and "E" appear to be adequate.

13. Recommended Improvements. Access Roads "G", "H", and "I" should be upgraded as shown on Plates C-1 and C-2, and discussed in paragraph 7. It should be noted that the road surface on the spillway bridge is only 12.5 feet wide and that some grading and gravel will be required for heavy equipment to work between the spillway channel and Reservoir Road.

F. ACCESS TO NORTH BRANCH DAM - TOES AND CREST

14. Existing Access. The North Branch of the dam is located approximately three miles upstream (north) of the main dam on the North Branch of the Black River. Reservoir Road, a 22 foot wide bituminous concrete road, runs across the crest of the North Branch Dam. The downstream toe of the North Branch Dam

is a slightly marshy area that is flanked by a steep abutment to the west and a flatter sloping abutment to the east. The upstream toe is inundated by a pool and is flanked by a steep abutment to the west and gently sloping abutment to the east. There are not any existing access roads to the upstream or downstream toes of the North Branch Dam.

15. Adequacy of Access. Access to the crest of the North Branch Dam is adequate. Access to the toes of the dam is inadequate.

16. Recommended Improvements. Access Road "N" should be constructed as shown on Plates C-1 and C-2 to improve access to the downstream toe of the North Branch Dam. Access Road "O" should be constructed to improve access to the upstream toe of the dam. It would be a 12-inch gravel road at existing grade. Clearing, grubbing and stripping would be required before placement and compaction would be performed. The east abutment should be kept clear of vegetation to allow light weight vehicle and inspection along the abutment and North Branch interface.

G. COST ESTIMATES

17. Cost Estimates.

Construction of Access Road "F"

Item	Qty	Unit	Unit Price ($)	Cost ($)
Mob-demob	1	Job	LS	2,000
Clearing	1	Job	LS	1,000
Excavation	110	CY	6.00	1,660
Random Fill	900	CY	8.00	7,200
Gravel Fill	200	CY	15.00	2,000
Subtotal				13,860
Contingency 20%				2,772
TOTAL				16,632
SAY				$17,000

Improvement to Access Road "G"

Item	Qty	Unit	Unit Price ($)	Cost ($)
Mob-demob	1	Job	LS	2,000
Random Fill	1,200	CY	8.00	9,600
Gravel Fill	160	CY	15.00	2,400
Subtotal				14,000
Contingency 20%				2,800
TOTAL				16,800
SAY				$17,000

Improvement to Access Road "H"

Item	Qty	Unit	Unit Price ($)	Cost ($)
Mob-demob	1	Job	LS	2,000
Excavation	300	CY	6.00	1,800
Random Fill	1,100	CY	8.00	8,800
Gravel Fill	300	CY	15.00	4,500
24" CMP	25	LF	50.00	1,250
Subtotal				18,350
Contingency 20%				3,670
TOTAL				22,020
SAY				$22,000

Improvement to Access Road "I"

Item	Qty	Unit	Unit Price ($)	Cost ($)
Mob-demob	1	Job	LS	2,000
Excavation	500	CY	6.00	3,000
Gravel Fill	1,000	CY	15.00	15,000
Subtotal				20,000
Contingency 20%				4,000
TOTAL				24,000
SAY				$24,000

Improvement to Access Road "K"

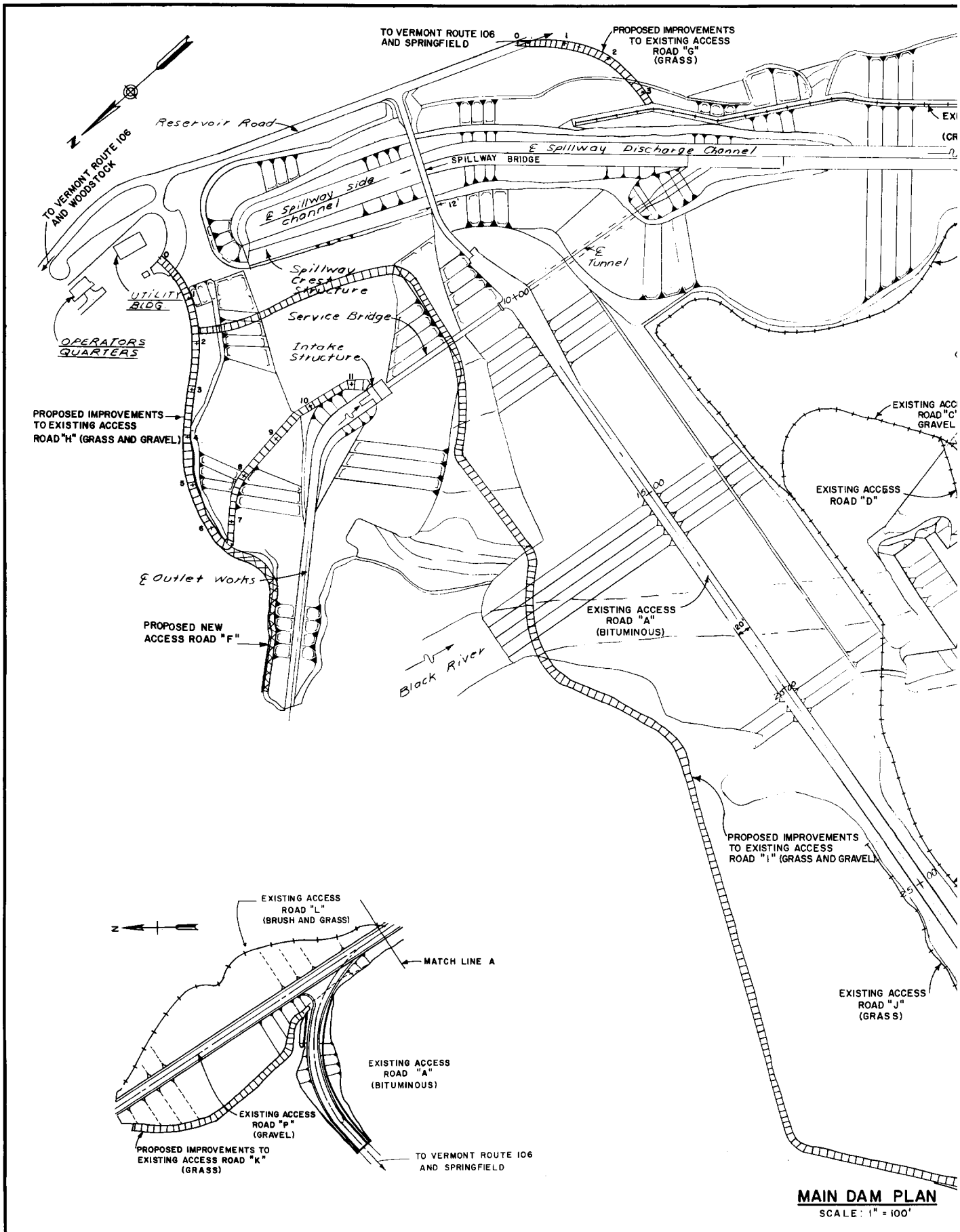
Item	Qty	Unit	Unit Price ($)	Cost ($)
Mob-demob	1	Job	LS	2,000
Clearing	1	Job	LS	1,000
Excavation	300	CY	6.00	1,800
Gravel Fill	300	CY	15.00	4,500
Subtotal				9,300
Contingency 20%				1,860
TOTAL				11,160
SAY				$11,000

Construction of Access Road "N"

Item	Qty	Unit	Unit Price ($)	Cost ($)
Mob-demob	1	Job	LS	2,000
Clearing	1	Job	LS	2,000
Excavation	1,300	CY	6.00	7,800
Gravel	200	CY	15.00	3,000
Crushed Stone	30	CY	25.00	750
Stone	300	CY	40.00	12,000
Subtotal				27,550
Contingency 20%				5,510
TOTAL				33,060
SAY				$33,000

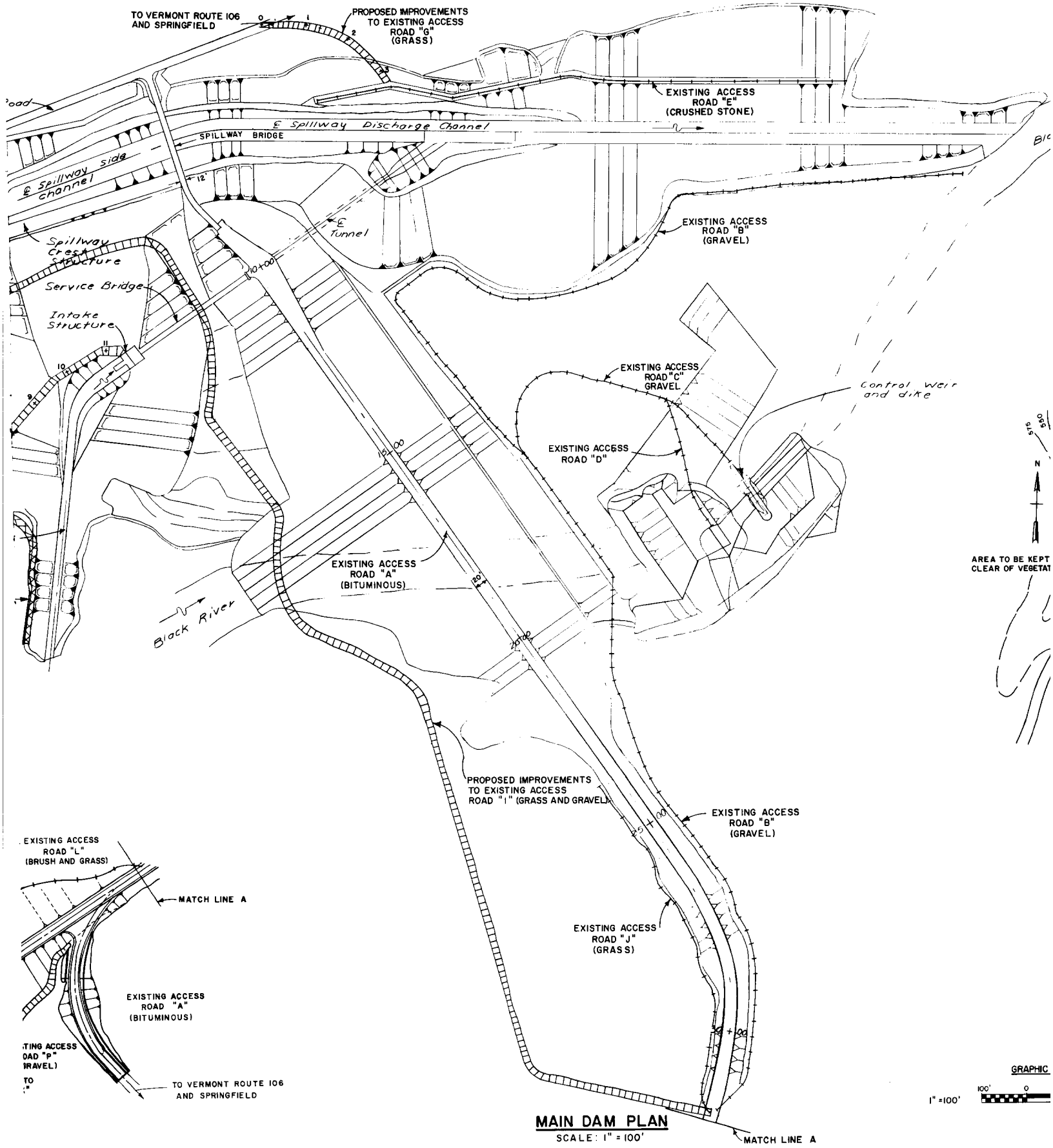
Construction of Access Road "O"

Item	Qty	Unit	Unit Price ($)	Cost ($)
Mob-demob	1	Job	LS	2,000
Clearing	1	Job	LS	1,000
Excavation	200	CY	6.00	1,200
Gravel Fill	200	CY	15.00	3,000
Subtotal				7,200
Contingency 20%				1,440
TOTAL				8,640
SAY				$9,000



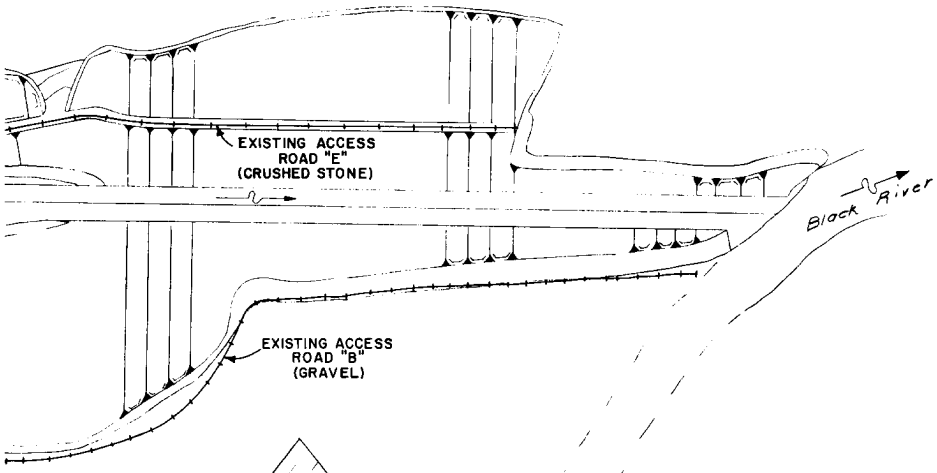
MAIN DAM PLAN

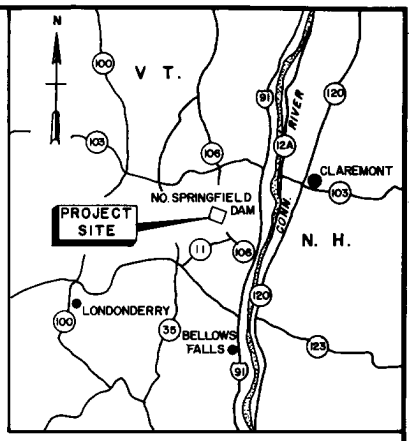
SCALE: 1" = 100'



MAIN DAM PLAN

SCALE: 1" = 100'

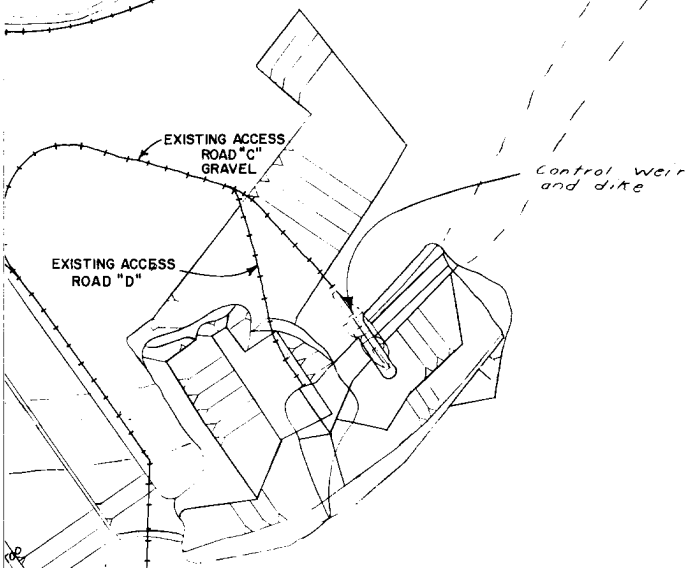


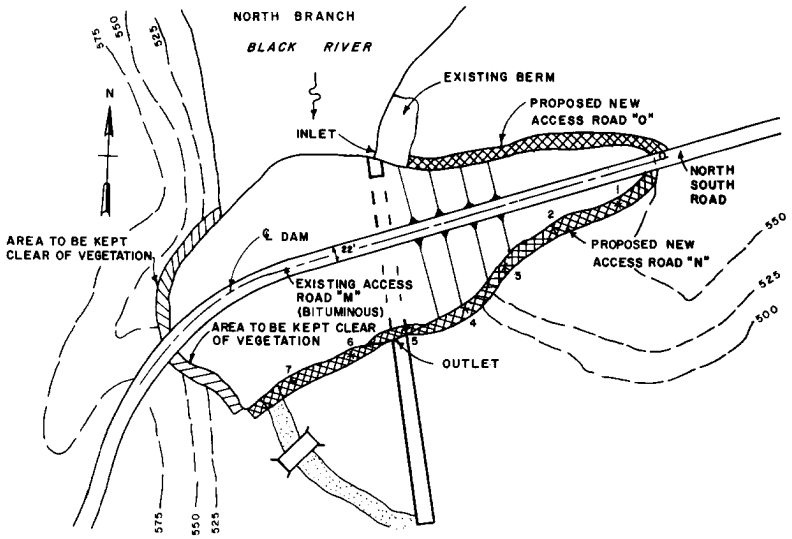


LOCATION MAP

SCALE IN MILES

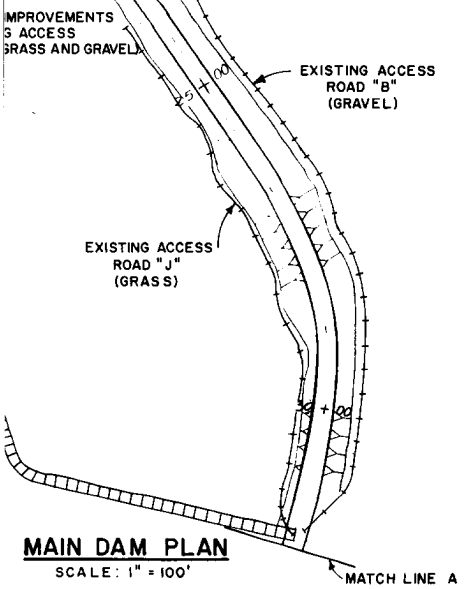
0 5 10 15 20





NORTH BRANCH DAM PLAN

N.T.S.



MAIN DAM PLAN

SCALE: 1" = 100'

LEGEND

- AREA TO BE KEPT CLEAR OF VEGETATION
- PROPOSED NEW ACCESS ROUTE
- PROPOSED IMPROVEMENTS TO EXISTING ACCESS ROUTE
- EXISTING ACCESS ROUTE
- $+^{3}$ STATIONING FOR PROFILES SHOWN ON PLATE C-2

GRAPHIC SCALES

1" = 100'

100' 0 100' 200'

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CORPS OF ENGINEERS
WALTHAM, MASS.

EMERGENCY ACCESS STUDY

UPPER CONNECTICUT RIVER BASIN

NORTH SPRINGFIELD LAKE

GENERAL PLAN

DES. BY:

DR. BY:

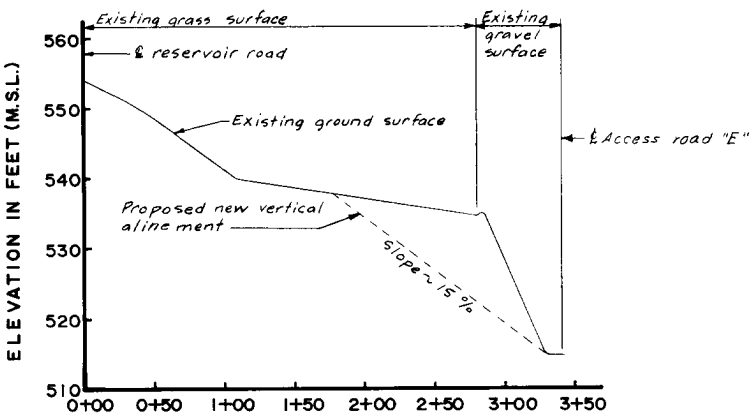
CK. BY:

GEOTECH. ENG. DIV.

PLATE C-1

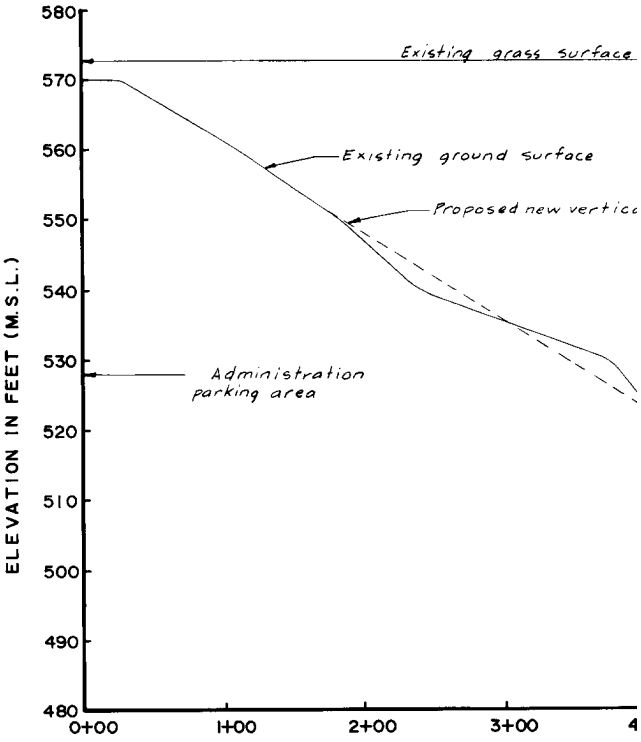
SCALE: AS SHOWN

DATE: SEPT. 1990

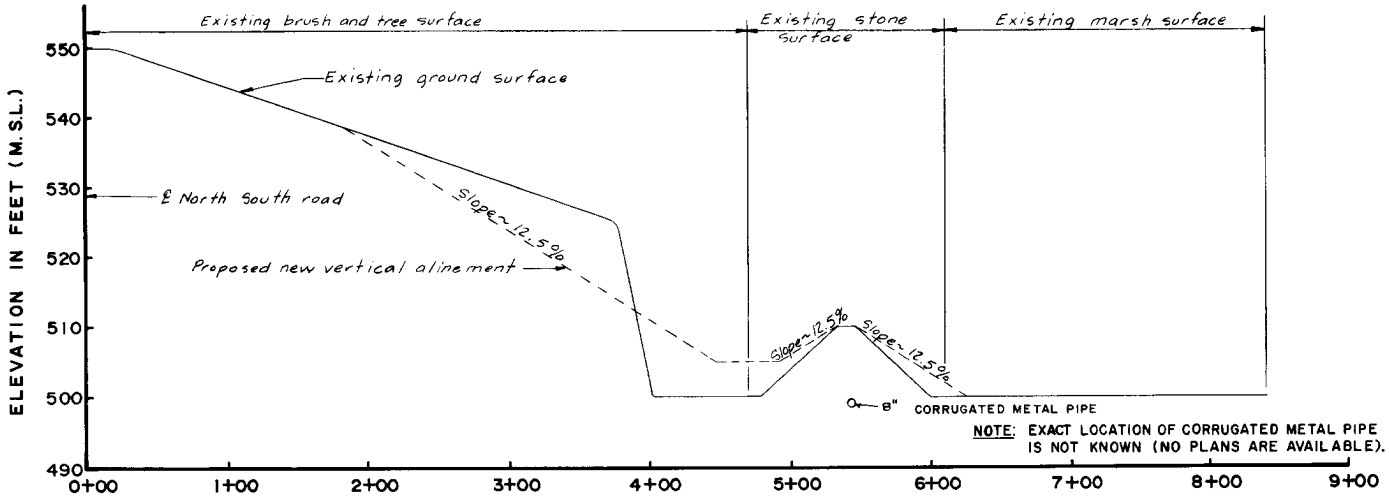


PROPOSED IMPROVEMENT ACCESS ROAD "G" PROFILE

SCALES: HOR. 1" = 50'
VERT. 1" = 10'



PROPOSED IMP

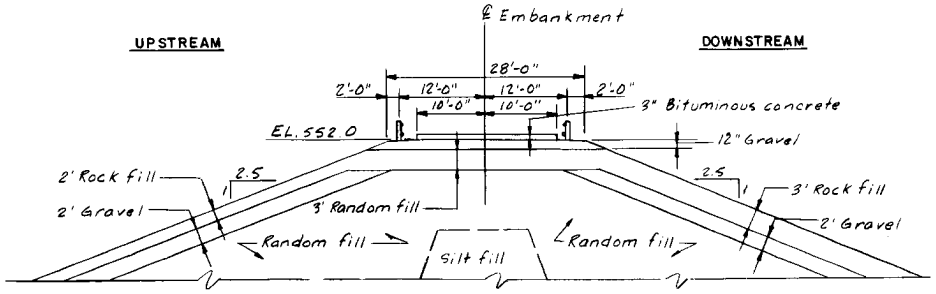


NOTE: EXACT LOCATION OF CORRUGATED METAL PIPE IS NOT KNOWN (NO PLANS ARE AVAILABLE).

PROPOSED ACCESS ROAD "N" PROFILE

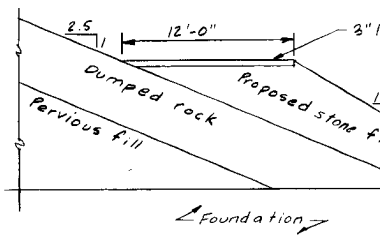
SCALES: HOR. 1" = 50'
VERT. 1" = 10'

TY



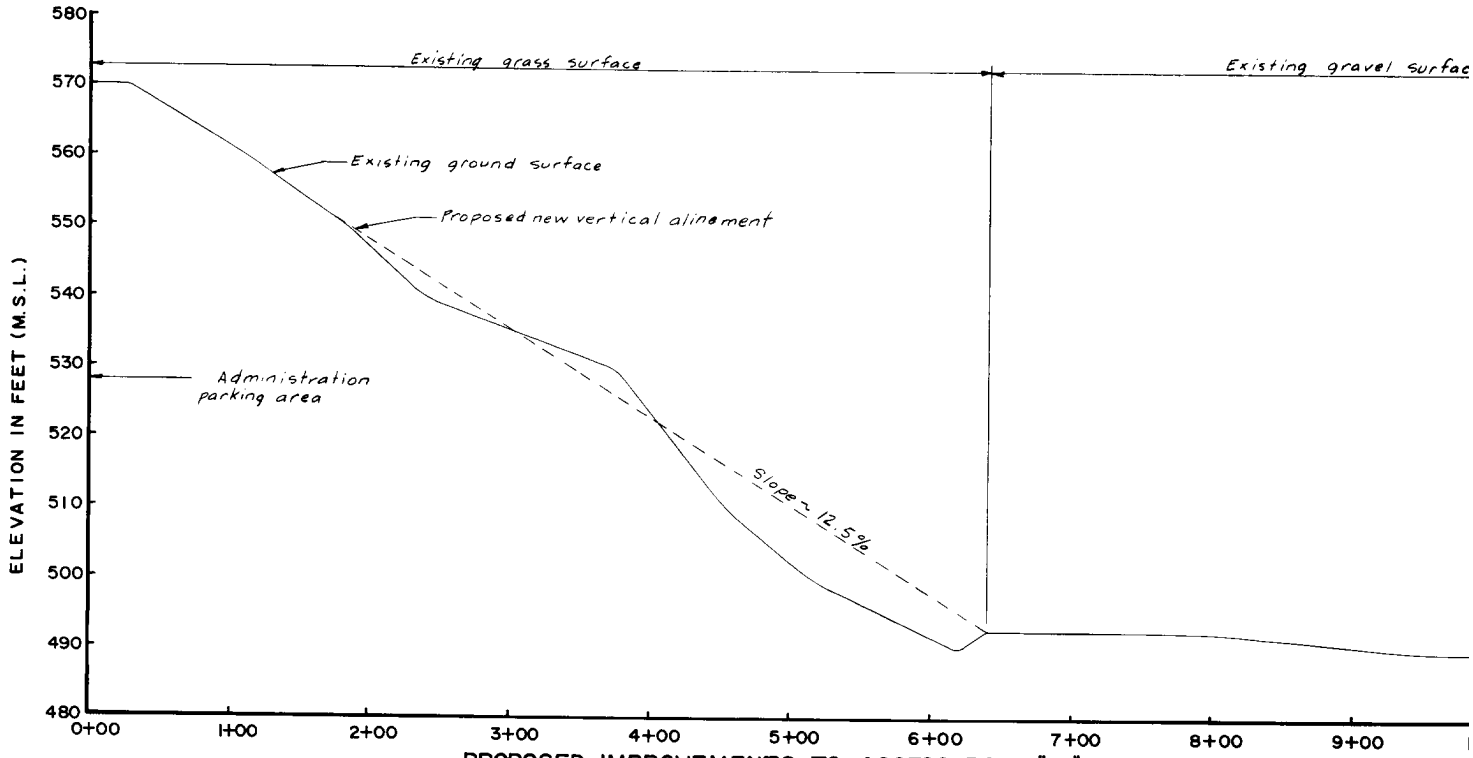
TYPICAL ACCESS ROAD "A" SECTION

SCALE: 1" = 10'



TYPICAL ROCK FILL SECTION FOR PROPOSED

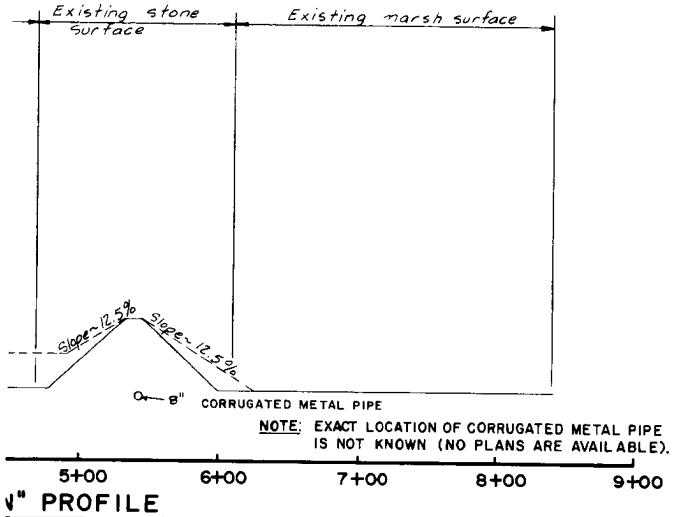
SCALE: 1" = 5'



"E"

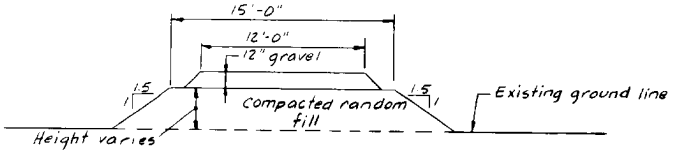
PROPOSED IMPROVEMENTS TO ACCESS ROAD "H" PROFILE

SCALES: HOR. 1" = 50'
VERT. 1" = 10'



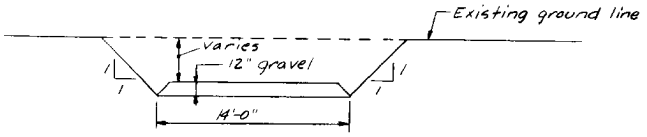
NOTE: EXACT LOCATION OF CORRUGATED METAL PIPE IS NOT KNOWN (NO PLANS ARE AVAILABLE).

N" PROFILE



TYPICAL FILL SECTION FOR PROPOSED ACCESS ROADS "H"

SCALE: 1" = 5'



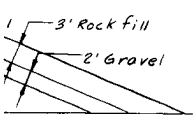
TYPICAL CUT SECTION FOR PROPOSED ACCESS ROADS "G","H","N","I","L

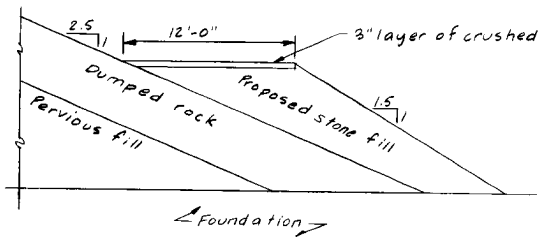
SCALE: 1" = 5'

ISTREAM

us concrete

Gravel

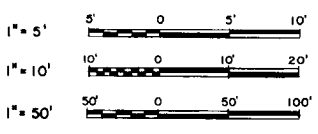




TYPICAL ROCK FILL SECTION FOR PROPOSED DAM ACCESS ROAD "N"

SCALE: 1" = 5'

GRAPHIC SCALES



DEPAR
NE
C

DES. BY.

DR. BY.

CK. BY.

EME
UPPER
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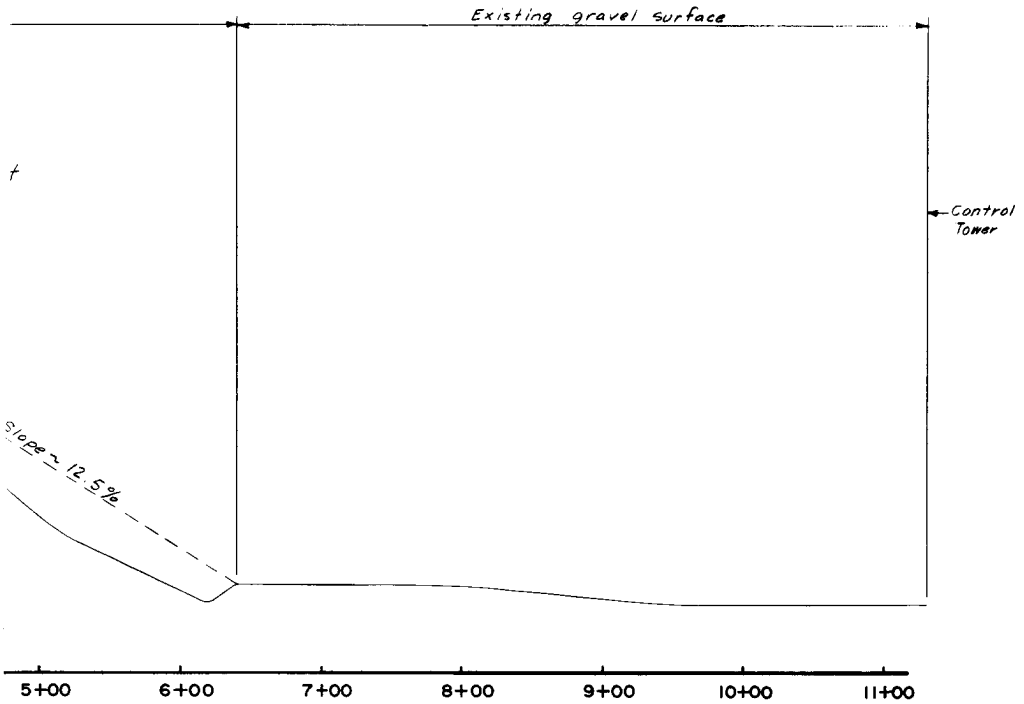
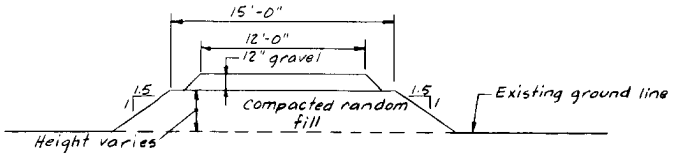
PI

GEOTECH. ENG. DIV.
PLATE C-2



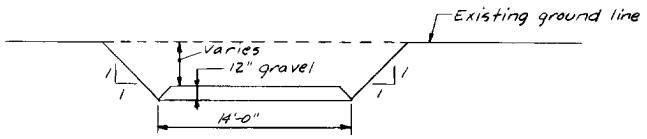
NTS TO ACCESS ROAD "H" PROFILE

SCALES: HOR. 1" = 50'
VERT. 1" = 10'



PICAL FILL SECTION FOR PROPOSED ACCESS ROADS "H"

SCALE: 1" = 5'



UT SECTION FOR PROPOSED ACCESS ROADS "G", "H", "N", "I", "L", "K", AND "O"

SCALE: 1" = 5'

shed stone

GRAPHIC SCALES

1" = 5' 5' 0 5' 10'

1" = 10' 10' 0 10' 20'

1" = 50' 50' 0 50' 100'

SS ROAD "N"

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WALTHAM, MASS.

DES. BY.

DR. BY.

CK. BY.

EMERGENCY ACCESS STUDY
UPPER CONNECTICUT RIVER BASIN
NORTH SPRINGFIELD LAKE
PROFILES AND SECTIONS

GEOTECH. ENG. DIV.
PLATE C-2

SCALE: AS SHOWN
DATE: SEPT. 1990

APPENDIX D

BALL MOUNTAIN LAKE

APPENDIX D
BALL MOUNTAIN LAKE

TABLE OF CONTENTS

Paragraph No.	Subject	Page No.
	A. Pertinent Data	
1.	Pertinent Data	D-1
	B. Access to Downstream Toe	
2.	Existing Access	D-2
3.	Adequacy of Access	D-2
4.	Recommended Improvements	D-2
	C. Access to Crest of Dam	
5.	Existing Access	D-3
6.	Adequacy of Access	D-3
7.	Recommended Improvements	D-3
	D. Access to Outlet Works	
8.	Existing Access	D-3
9.	Adequacy of Access	D-4
10.	Recommended Improvements	D-4
	E. Access to Spillway - Channel and Weir	
11.	Existing Access	D-4
12.	Adequacy of Access	D-4
13.	Recommended Improvements	D-4
	F. Cost Estimates	
14.	Cost Estimates	D-5

LIST OF PLATES

Plate No.	Title
D-1	Ball Mountain Lake - Plan and Sections

APPENDIX D

BALL MOUNTAIN LAKE

A. PERTINENT DATA

1. Pertinent Data.

LOCATION: The dam is on the West River, 29 miles above the river's junction with the Connecticut River at Brattleboro, Vermont. The project is located in the towns of Jamaica and Londonderry, Windham County, Vermont.

CONSTRUCTION PERIOD: May 1957 to October 1961

PURPOSE: The reservoir is operated as a unit of the comprehensive plan for flood control in the Connecticut River Basin. Recreation facilities are also provided.

RESERVOIR:

Drainage Area: 172 Square Miles

Operating Levels:

Pool	Elevation (ft, NGVD)	Area (acres)	Cumulative Capacity (acre-ft)
Inlet	805.5	0	0
Permanent	830.5	20	240
Conservation	870.5	75	2.240
Flood Control (Spillway Crest)	1,017.0	810	54,690

DAM:

Type:	Rolled earth fill, rock slope protection, impervious core
Maximum Height (ft):	265
Length (ft):	915
Top Elevation (ft, NGVD):	1,052.0

SPILLWAY:

Location:	Right abutment
Type:	Uncontrolled ogee weir & chute spillway in rock
Crest Length (ft):	235
Crest Elevation (ft, NGVD):	1,017.0
Maximum Discharge Capacity (cfs):	150,000

OUTLET WORKS:

Type:	Circular concrete tunnel
Size:	13'-6" diameter
Length (ft):	864
Gates:	(3) Service 5'-8" x 10'-0" hydraulic slide
Discharge at Spillway Crest (cfs):	10,400
Stilling Basin:	None

B. ACCESS TO DOWNSTREAM TOE

2. Existing Access. The downstream toe area of Ball Mountain Dam is heavily vegetated and has a rough terrain. It is flanked by extremely steep abutments which rise several hundred feet above the crest of the dam. During construction of the dam, the downstream toe was reached by traveling north from Route 30 at the Town of Jamaica center for approximately one-fourth mile to an old railroad bed on the east side of the West River and then following the old railroad bed, which runs adjacent to the river, approximately three miles to the dam site. The old railroad bed is approximately 15 feet wide and has a gravel surface. Its surface is approximately 20 feet above the West River, and is in good condition except for the section from Cobb Brook (approximately three-fourths mile downstream of the dam) to the dam. The Cobb Brook to dam section of the Old Railroad bed is overgrown and not passible by even light weight equipment. Two of the slopes along the bed upstream of Cobb Brook have grades of approximately 20 percent. In addition, Cobb Brook is extremely flashing and becomes difficult to cross after heavy rains. A field visit for the access study at Ball Mountain Lake was made 7 August 1990. Six inches of rain had recently fallen in the Ball Mountain Area. Cobb Brook had swelled to approximately 30 feet in width and one foot in depth.

3. Adequacy of Access. Access to the downstream toe of Ball Mountain Dam is inadequate. The downstream toe of the dam can only be reached by foot at the present time.

4. Recommended Improvements. The old railroad bed should be improved to allow access to the downstream toe of Ball Mountain Dam. Coordination with the State of Vermont will be required to accomplish the improvements because the old railroad bed passes through Jamaica State Park. The proposed improvements would include: placement of six inches of gravel downstream of Cobb Brook and 12 inches of gravel upstream of Cobb Brook, clearing and grubbing upstream of Cobb Brook, installation of approximately 20 drainage pipes (18-inch diameter by 25 foot long corrugated metal pipes, construction of six passing zones, flattening two slopes with grades approximately 20 percent (80 and 160 feet long) upstream of Cobb Brook, and installation of a bridge (four 48-inch diameter by 30 foot long corrugated metal pipes) at Cobb Brook. Typical cut and fill sections for the proposed improvements are shown on Plate D-1. In addition to the proposed improvements to Access Road "F" the interfaces between the dam and downstream abutments should be kept clear of vegetation to allow for inspection.

C. ACCESS TO CREST OF DAM

5. Existing Access. A 20-foot wide gravel road (Access Road "A") extends across the crest of Ball Mountain Dam. It can be reached by traveling north from Vermont State Route 30 on Access Road "E" (a 22-foot wide bituminous concrete road) approximately one mile bearing left on Access Road "D" (a 16-foot wide bituminous concrete road) to the spillway approach channel, crossing the spillway approach channel on Access Road "C" (the gravel surface of the approach channel), and crossing the upstream slope of the dam on Access Road "B" (a 10-foot wide gravel road) to the north end of Access Road "A". This access route to the crest of the dam can be used until the pool level reaches approximately 970 feet mean sea level (approximately 80 feet below the crest of the dam). Only a small portion (approximately 25 percent) of the dam's upstream slope can be reached from Access Road "B". The remainder of the upstream slope is difficult, if not nearly impossible, to reach because the adjacent abutments are extremely steep. It appears the only way to reach the lower portion of the upstream toe is by completely lowering the pool.

6. Adequacy of Access. Heavy equipment cannot reach the crest of Ball Mountain Dam once the pool has reached approximately elevation 970 feet NGVD. Access to the lower portion of the upstream toe is difficult even at low water conditions.

7. Recommended Improvements. Two options were considered for improving access to the crest of Ball Mountain Dam. Option A was to construct a bridge from the rotary that would gradually turn into the crest of dam. The bridge would be approximately 15 feet wide and 600 feet long. It would be supported by two abutments and five piers. Option B was to cut a road into the rock face along south wall of the approach channel to the weir area and construct a short curved bridge across the spillway to the dam crest. The rock cut would provide a 15 foot wide road surface at approximately elevation 1052 feet NGVD. The bridge would be approximately 15 feet wide and 300 feet long. It would be supported by two abutments and two piers. Both options would require that a larger turn around be constructed at the north end of the dam crest. Option B was more economical and blocked less of the spillway approach channel. It is also recommended that vegetation be kept off the abutments to allow for inspection.

D. ACCESS TO OUTLET WORKS

8. Existing Access. The inlet channel and structure are inundated by the normal pool at Ball Mountain Lake. They can only easily be reached by boat unless the pool is lowered. Then they could be reached by lowering light equipment down from Access Road "D" or the service bridge. Access Road "D" is a 16 foot wide road with a bituminous concrete surface that is parallel and 0 to 100 feet north of Access Road "E". The same difficulties to reach the downstream toe at Ball Mountain dam which were discussed in paragraph 2 apply to the outlet channel and structure of the dam. The improvements to Access Road "F" discussed in paragraph 5 for the downstream toe would also improve access to the outlet channel and structure.

9. Adequacy of Access. Access to the outlet works at Ball Mountain Lake is inadequate.

10. Recommended Improvements. Access Road "F" should be upgraded as discussed in paragraph 5 to improve access to the outlet channel and structure of Ball Mountain Lake.

E. ACCESS TO SPILLWAY - CHANNEL AND WEIR

11. Existing Access. The spillway approach channel and weir at Ball Mountain Dam can be reached using Access roads "E" and "D" from Vermont State Route 30 until the pool rises to approximately elevation 970 NGVD. Gravel ramps could be used to bridge over the weir and access the discharge channel from the approach channel. However, the discharge channel becomes very steep (grades 25 percent or greater) just downstream of the weir which would make it hard for heavy equipment to operate on it. Access to base of the discharge channel and to the entire spillway channel when the pool is higher than 970 feet NGVD is extremely difficult because the channel sides and slopes are extremely steep and rugged.

12. Adequacy of Access. Access to approach spillway channel and weir at Ball Mountain Lake is inadequate once the pool rises above elevation 970 feet NGVD. Access to the discharge channel during high water is adequate because it appears that blockage could not occur on the steep channel slopes.

13. Recommended Improvements. It is recommended that one of the two schemes to reach the crest discussed in paragraph 7 be implemented. Either one of the schemes would allow for access to the weir and approach channel during high pool conditions.

F. COST ESTIMATES

14. Cost Estimates.

Improvement to Access Road "A" (Option A)

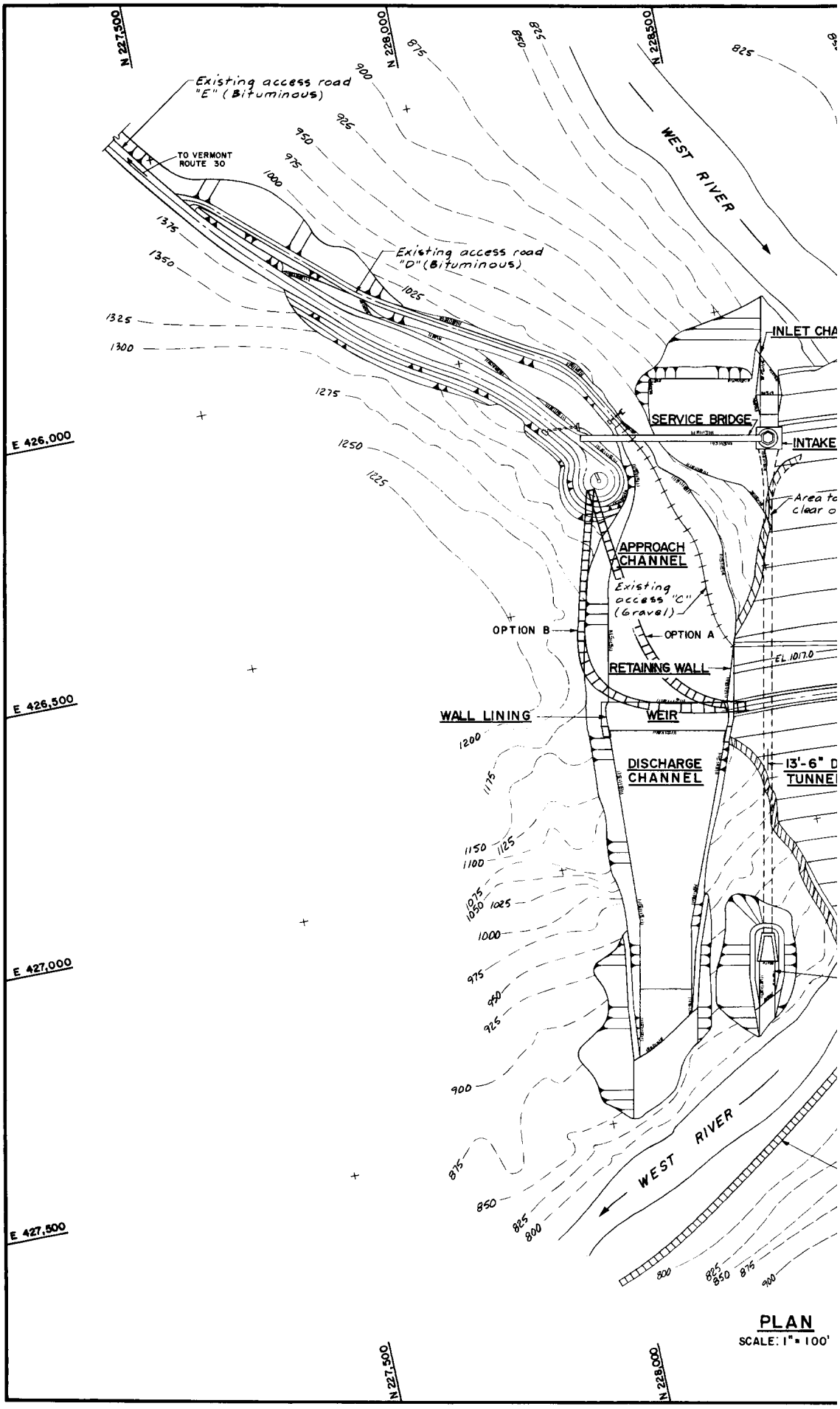
Item	Qty	Unit	Unit Price ($)	Cost ($)
Mob-demob	1	Job	LS	10,000
Bridge Deck	9,000	SF	100.00	900,000
Piers	700	CY	500.00	350,000
Abutments	200	CY	500.00	100,000
Guardrails	1,200	LF	45.00	54,000
Excavation (General)	10,000	CY	6.00	60,000
Excavation (Blasted Rock)	150	CY	30.00	4,500
Random Fill	10,000	CY	8.00	80,000
Rock Fill	500	CY	40.00	20,000
Gravel Fill	100	CY	15.00	1,500
Subtotal				1,580,000
Contingency 40%				632,000
TOTAL				2,212,000
SAY				$2,200,000

Improvement to Access Road "A" (Option B)

Item	Qty	Unit	Unit Price ($)	Cost ($)
Mob-demob	1	Job	LS	10,000
Bridge Deck	4,500	SY	100.00	450,000
Piers	300	CY	500.00	150,000
Abutments	200	CY	500.00	100,000
Guardrails	950	LF	45.00	42,750
Excavation (General)	5,000	CY	6.00	30,000
Excavation (Blasted Rock)	13,000	CY	30.00	390,000
Random Fill	5,000	CY	8.00	40,000
Rock Fill	500	CY	40.00	20,000
Gravel Fill	300	CY	15.00	4,500
Subtotal				1,237,250
Contingency 40%				494,900
TOTAL				1,732,150
SAY				$1,700,000

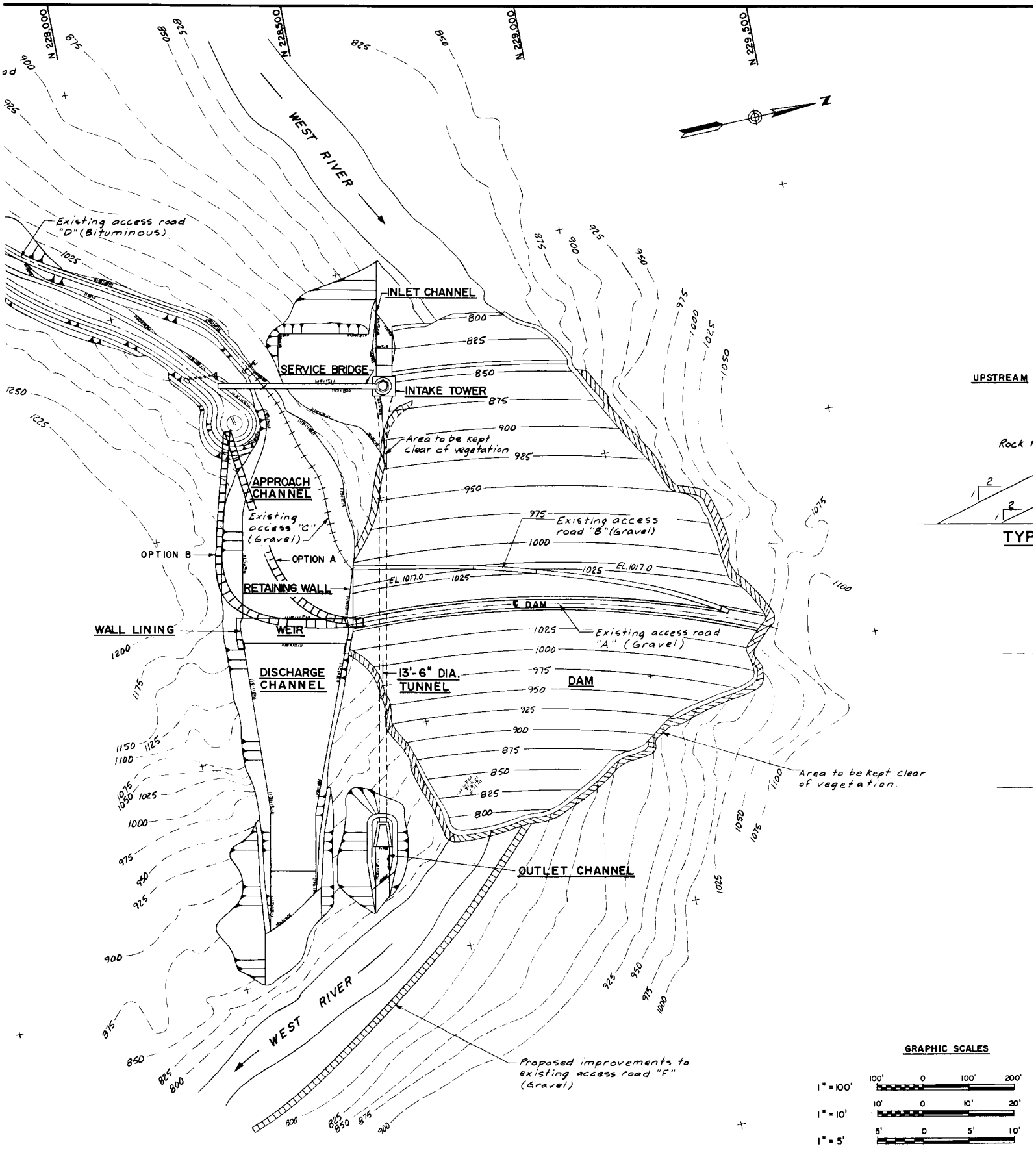
Improvement to Access Road "F"

Item	Qty	Unit	Unit Price ($)	Cost ($)
Mob-demob	1	Job	LS	5,000
Gravel Fill	5,000	CY	15.00	75,000
24" CMP	500	LF	50.00	25,000
48" CMP	120	LF	100.00	12,000
Excavation	3,500	CY	6.00	21,000
Random Fill	4,000	CY	8.00	32,000
Subtotal				170,000
Contingency 20%				34,000
TOTAL				204,000
SAY				$200,000



PLAN

SCALE: 1" = 100'

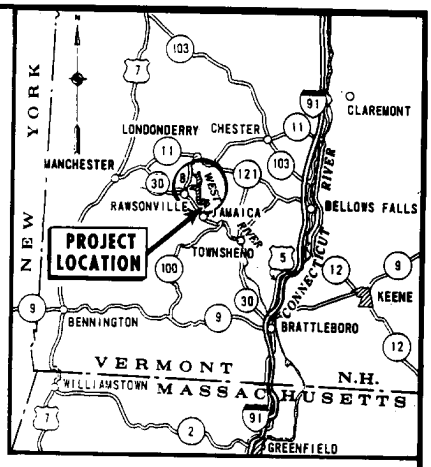


PLAN

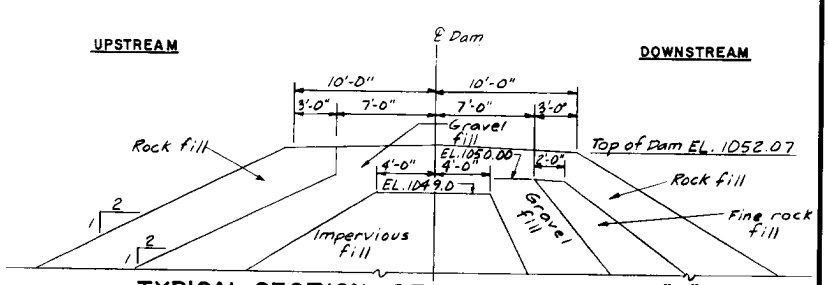
SCALE: 1" = 100'

N 229,500

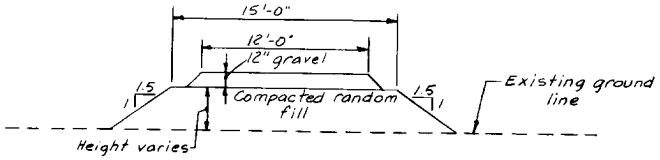
N



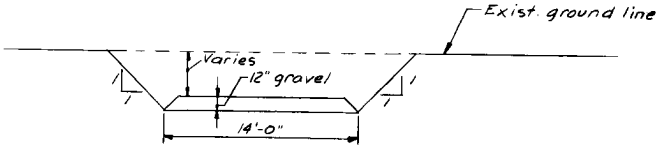
VICINITY MAP
SCALE IN MILES
5 0 5 10 15



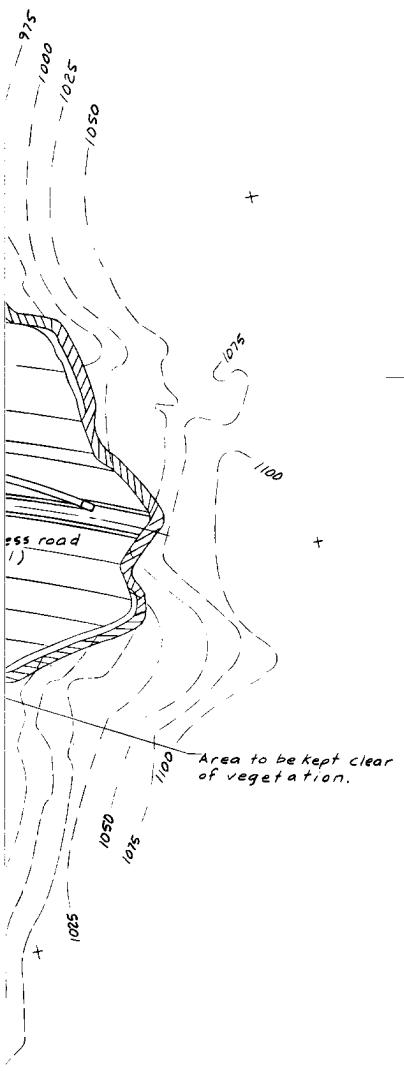
TYPICAL SECTION OF ACCESS ROAD "A"
SCALE: 1" = 10'



TYPICAL FILL SECTION FOR PROPOSED IMPROVEMENTS TO ACCESS ROAD "F"
SCALE: 1" = 5'



TYPICAL CUT SECTION FOR PROPOSED IMPROVEMENTS TO ACCESS ROAD "F"
SCALE: 1" = 5'



LEGEND

- AREA TO BE KEPT CLEAR OF VEGETATION
- PROPOSED IMPROVEMENTS TO EXISTING ACCESS ROUTE
- EXISTING ACCESS ROUTE

GRAPHIC SCALES

1" = 100' — 100' 0 100' 200'
1" = 10' — 10' 0 10' 20'
1" = 5' — 5' 0 5' 10'

N 229,000

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WALTHAM, MASS.

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DR. BY.
CK. BY.

EMERGENCY ACCESS STUDY
LOWER CONNECTICUT RIVER BASIN
BALL MOUNTAIN LAKE
PLAN AND SECTIONS

GEOTECH. ENG. DIV.
PLATE D-1

SCALE: AS SHOWN
DATE: SEPT. 1990

APPENDIX E

TOWNSHEND LAKE

APPENDIX E
TOWNSHEND LAKE

TABLE OF CONTENTS

Paragraph No.	Subject	Page No.
	A. Pertinent Data	
1.	Pertinent Data	E-1
	B. Access to Downstream Toe	
2.	Existing Access	E-2
3.	Adequacy of Access	E-2
4.	Recommended Improvements	E-2
	C. Access to Crest of Dam	
5.	Existing Access	E-3
6.	Adequacy of Access	E-3
7.	Recommended Improvements	E-3
	D. Access to Outlet Works	
8.	Existing Access	E-3
9.	Adequacy of Access	E-3
10.	Recommended Improvements	E-4
	E. Access to Spillway - Channel and Weir	
11.	Existing Access	E-4
12.	Adequacy of Access	E-4
13.	Recommended Improvements	E-4
	F. Cost Estimates	
14.	Cost Estimates	E-5

LIST OF PLATES

Plate No.	Title
E-1	Townshend Lake - General Plan
E-2	Townshend Lake - Profiles and Sections

APPENDIX E

TOWNSHEND LAKE

A. PERTINENT DATA

1. Pertinent Data.

LOCATION: The dam is on the West River, 19.1 miles above the river's confluence with the Connecticut River at Brattleboro, Vermont and about two miles west of Townshend, Vermont. The project lies within the towns of Townshend and Jamaica, Windham County, Vermont.

CONSTRUCTION PERIOD: November 1958 to June 1961

PURPOSE: The reservoir is operated as a unit of a coordinated system of reservoirs for flood control in the Connecticut River Basin. Although not specifically authorized, recreational facilities are provided.

RESERVOIR:

Drainage Area: 278 square miles gross &
106 square miles net

Operating Levels:

Pool	Elevation (ft, NGVD)	Area (acres)	Cumulative Capacity (acre-ft)
Inlet	457.0	0	0
Recreation	478.0	95	800
Flood Control (Spillway Crest)	553.0	735	33,700

DAM:

Type:	Rolled earth fill, rock slope protection, impervious core
Maximum Height (ft):	133
Length (ft):	1,700
Top Elevation (ft, NGVD):	583.0

SPILLWAY:

Location:	Left abutment
Type:	Uncontrolled ogee weir, L-shaped side channel spillway
Crest Length (ft):	439
Crest Elevation (ft, NGVD):	553.0
Maximum Discharge Capacity (cfs):	201,000

OUTLET WORKS:

Type:	Horseshoe-shaped concrete conduit
Size:	20'-6" diameter
Length (ft):	360
Gates:	(3) Service 7'-6" x 17'-0" vertical lift (wheel)
Discharge at Spillway Crest (cfs):	22,100
Stilling Basin:	None

B. ACCESS TO DOWNSTREAM TOE

2. Existing Access. The central downstream toe area of Townshend Dam is a flat area with mixture of grass areas and coniferous trees. The seepage control weir and outlet channel and structure are located in the central downstream toe area. Two rugged and heavily vegetated abutments flank the central toe area. The emergency spillway discharge channel (an approximately 100 foot deep cut) is situated in the east abutment.

Access Roads "D" and "E" are used to reach the downstream toe area. Access Road "E" extends westerly from Vermont State Route 30, across the downstream end of the discharge channel, around the upstream end of the outlet structure, and then southerly across the toe of the dam to Access Road "D". Access Road "E" is a 12 foot wide gravel road which has gentle slopes except for one short section (approximately 40 feet) between the discharge and outlet channels. The section of Access road "E" which crosses the discharge channel was washed out in 1987. It was replaced with an eight foot high berm. An 18-inch diameter by 25 foot long corrugated outlet pipe was installed in the berm to allow drainage from the discharge channel to pass through the berm but it is not large enough to handle run-off during large storms. Access Road "D" extends southeasterly from Access Road "A" (crest of dam) approximately 750 feet and then northeasterly approximately 1500 feet across the downstream toe area of the dam. It is a 12 foot wide gravel road which has three steep sections (approximately 120, 350 and 70 feet). Heavy equipment has had difficulty using it in the past and the steep sections become rutted easily.

3. Adequacy of Access. Access Road "D" provides good access for all types of vehicles to the downstream toe of the dam except when spillway discharge or heavy storm run-off inundate the road section at the end of the discharge channel. Only light weight vehicles can safely use Access Road "E" to reach the downstream toe of the dam because the road has three very steep sections. However, the Access Road "E" does provide access during spillway discharge conditions.

4. Recommended Improvements. The three steep sections of Access Road "D" should be flattened as shown on Plate E-2 so all types of vehicles can use it during spillway discharge conditions. The 18-inch diameter corrugated pipe opening under Access Road "E" at the end of the discharge channel should be increased (current estimate is a six foot diameter) so the road is not inundated by heavy storm run-off.

C. ACCESS TO CREST OF DAM

5. Existing Access. A 24-foot wide bituminous road (Access Road "A") crosses the crest of Townshend Dam. The east end of Access Road "A" crosses the spillway bridge (road width is 12.5 feet) and intersects with Vermont State Route 30. The west end of Access Road "A" intersects with Town Road. Town Road is a north-south gravel road which goes to Wardsboro (west) and Townshend (south). One of the bridges on Town Road which is located to the south of the dam has a 24,000 pound load limit.

Access Road "C" services the upstream toe of Townshend Dam during low water conditions (pool elevations 480 feet NGVD and lower). It can be reached by proceeding north on Access Road "B" approximately 1100 feet from the west crest of the dam. Access Road "B" is 20 feet wide, has a bituminous concrete surface and has a slight grade (visually estimated at two to three percent). Access Road "C" has a random fill surface road which rises and falls steeply before it reaches the upstream toe of the dam. Deep ruts and vegetation were observed frequently along Access Road "C".

6. Adequacy of Access. Access to the crest of Townshend Dam is excellent along Access Road "A". Access to the upstream toe of the dam is possible during low water conditions (up to approximately 480 feet NGVD) along Access Road "C". However, heavy equipment would have difficulty operating on the steep slopes and the soft spots have developed around the ruts along Access Road "C" to reach the upstream toe of the dam after high water had receded.

7. Recommended Improvements. The initial section of Access Road "C" should be flattened as shown on Plate E-2. Also 12 inches of gravel should be placed over the existing random fill surface of Access Road "C".

D. ACCESS TO OUTLET WORKS

8. Existing Access. The inlet structure can be reached from the service bridge, Access Road "C" and Access Road "F". The service bridge deck is a 12 foot wide steel grate that spans from Access Road "A" to the inlet tower. Access Road "C" can be used to reach the west side of the inlet structure and channel until the pool reaches approximately elevation 480 feet NGVD. It is described in section 5 above. Access Road "F" is a bituminous and gravel road which extends from Vermont State Route 30 to the east side of the inlet channel and structure. It is passable until the pool level reaches approximately elevation 480 feet NGVD. A bulldozer would have to remove debris and soft spots along Access Road "F" because it has been used only occasionally since construction of the dam and has not been maintained. Access Roads "D" and "E" service the outlet structure and channel area. They are described in section 2 above.

9. Adequacy of Access. The inlet structure can not be reached when the pool is above elevation 480 feet NGVD except from the service bridge. When the pool is below elevation 480 feet NGVD improvements are needed to Access Roads "C" and "F" to allow heavy equipment to reach the inlet structure. All types

of equipment can reach the outlet structure using Access Road "E" until spillway discharge (pool elevation 553 feet NGVD) occurs. Access to the outlet structure is possible using Access Road "D" during all pool conditions but is limited to light weight vehicles due to the steepness of the slopes.

10. Recommended Improvements. Access Road "C" should be upgraded as described in Section 7 above to provide better access to the inlet structure. Regular maintenance to Access Road "F" should be considered because it could provide access to the inlet structure and north end of the spillway channel (described below) when pool elevations are below elevation 480 feet NGVD. Access Roads "D" and "E" should be improved as described in section 4 to provide better access to the outlet structure.

E. ACCESS TO SPILLWAY - CHANNEL AND WEIR

11. Existing Access. The upstream portion of the spillway channel (approximately 400 feet) can be reached from the spillway bridge and a parking lot during spillway discharge conditions. The spillway bridge has a 12.5 feet wide concrete deck. It connects Access Road "A" to Vermont State Route 30. The parking lot is situated between Vermont State Route 30 and the spillway channel and has a bituminous surface. The upstream spillway area could also be reached by using Access road "F" (discussed in Section 8) when the pool is below elevation 480 feet NGVD.

The downstream portion of the spillway channel (approximately 1,000 feet) can easily be reached by traveling up the channel bottom from Access Road "E" (discussed in section 2). Access to the spillway channel by using Access Road "E" is possible until spillway discharge occurs. It would require significant amounts of gravel and perhaps stone to bridge the existing bumps in the channel bottom. The gravel probably would not stay in place if spillway discharge occurred. Access along the top edge of the spillway channel is very difficult due to the rugged terrain in the area.

12. Adequacy of Access. Access to the spillway channel and weir is very good except for the downstream portion of the channel when spillway discharge occurs. A significant amount of design and construction funds would be required to improve access in the downstream portion of the channel and is beyond the scope of this study.

13. Recommended Improvements. Improvements to existing access to the spillway weir and channel are not recommended at this time.

F. COST ESTIMATES

14. Cost Estimates.

Improvement to Access Road "C"

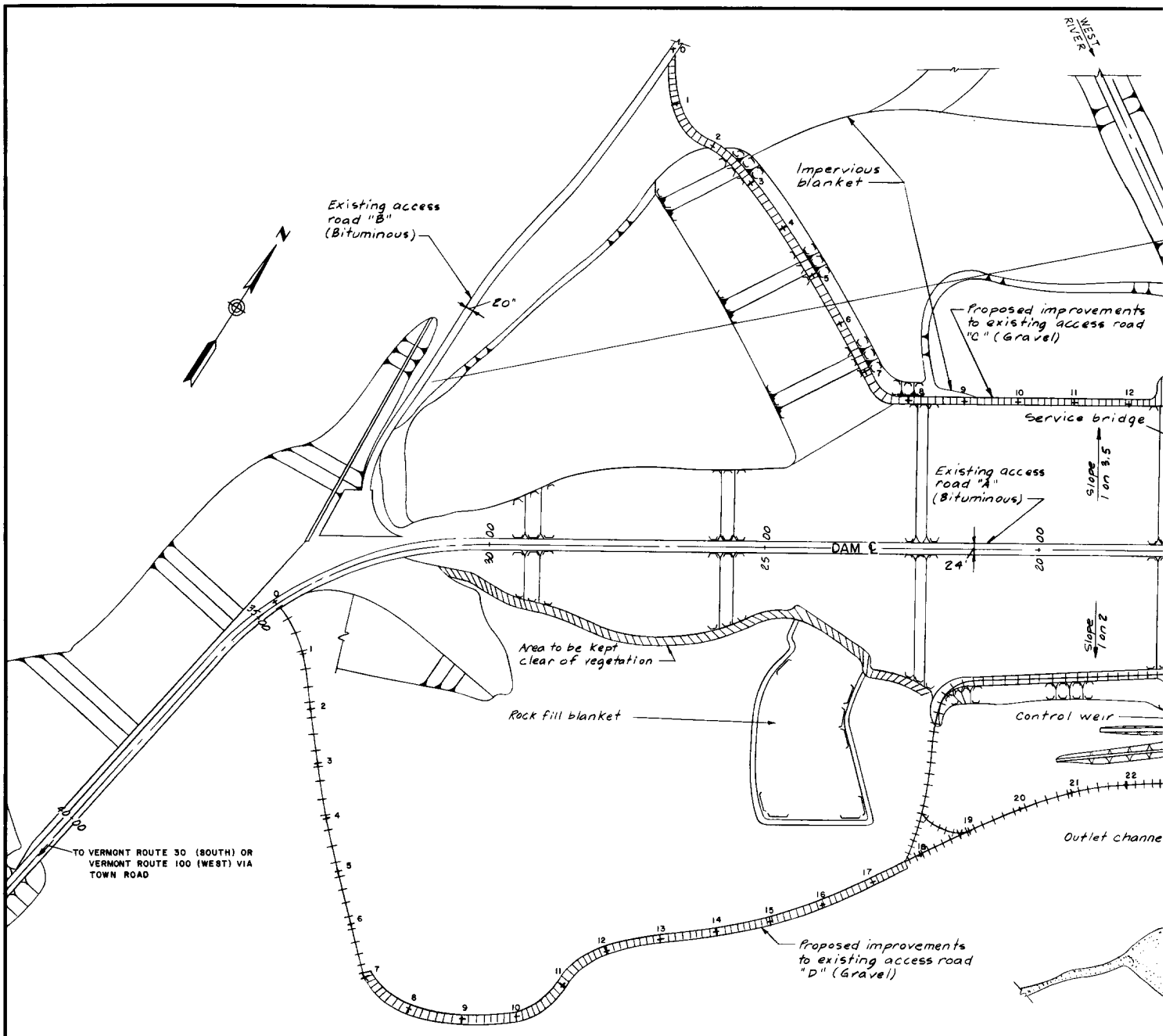
Item	Qty	Unit	Unit Price ($)	Cost ($)
Mob-demob	1	Job	LS	2,000
Gravel Fill	400	CY	15.00	6,000
Excavation	800	CY	6.00	4,800
Random Fill	300	CY	8.00	2,400
24" CMP	25	LF	50.00	1,250
Gate	1	EA	750.00	750
Subtotal				17,200
Contingency 20%				3,440
TOTAL				20,640
SAY				$21,000

Improvement to Access Road "D"

Item	Qty	Unit	Unit Price ($)	Cost ($)
Mob-demob	1	Job	LS	2,000
Excavation	1,000	CY	6.00	6,000
Random Fill	1,100	CY	8.00	8,800
Gravel Fill	200	CY	15.00	3,000
Subtotal				19,800
Contingency 20%				3,960
TOTAL				23,760
SAY				$24,000

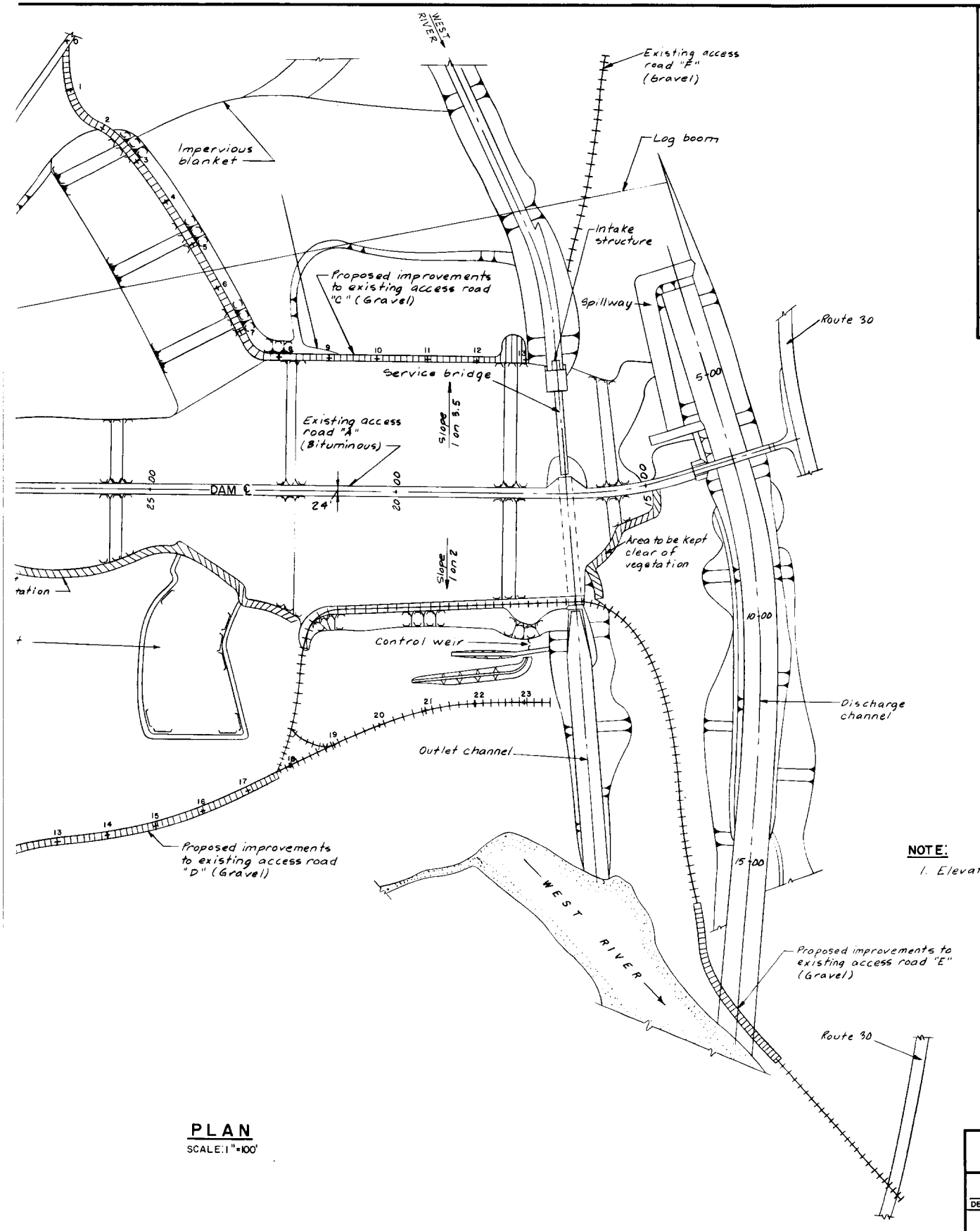
Improvement to Access Road "E"

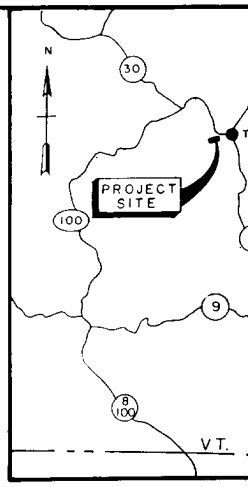
Item	Qty	Unit	Unit Price ($)	Cost ($)
Mob-demob	1	Job	LS	2,000
Excavation	300	CY	6.00	1,800
Random Fill	250	CY	8.00	2,000
Gravel Fill	50	CY	15.00	750
36" CMP	100	LF	75.00	7,500
Subtotal				14,050
Contingency 20%				2,810
TOTAL				16,860
SAY				$17,000



PLAN

SCALE: 1"=100'





LOCATIO

SCALE:

5 0

LEGEN

AREA TO BE KEPT C

PROPOSED NEW AC

PROPOSED IMPROVE

EXISTING ACCESS

+4 STATIONING FOR F

NOTE:

1. Elevations shown on this she

PLAN

SCALE: 1"=100'

GRAPHIC SCALE

1"=100' 100' 0 100' 200'

DEPARTMEN
NEW ENG
CORPS O
WALT

DES. BY.

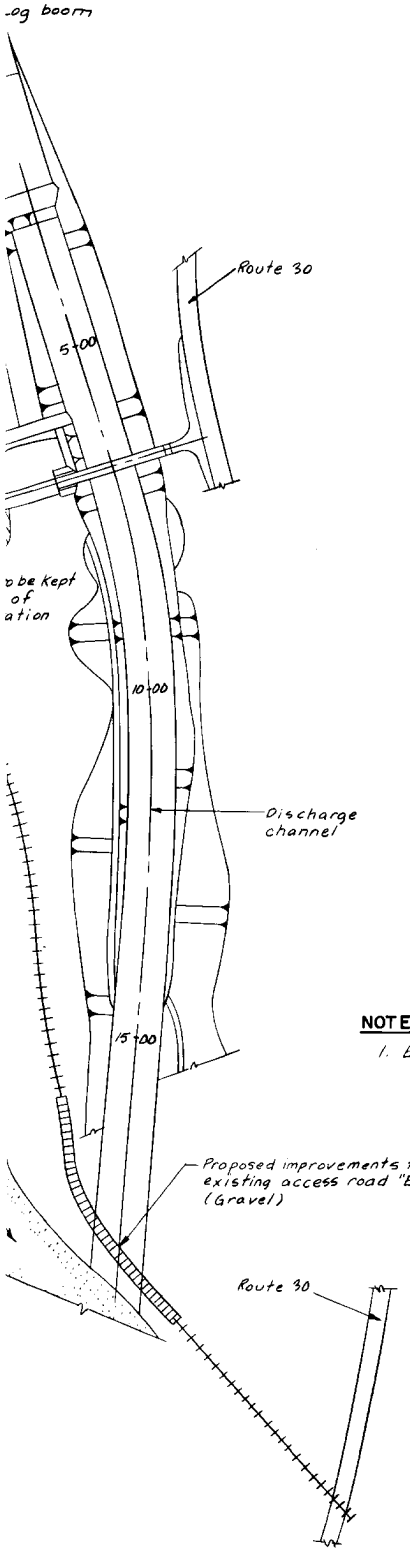
DR. BY.

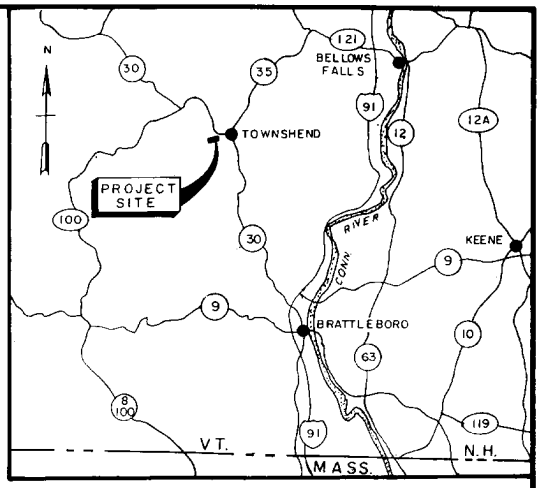
CK. BY.

EMERGE
UPPER CO

T

GEOTECH. ENG. DIV.
PLATE E-1





LOCATION MAP

SCALE: 1" = 5 MI.

5 0 5 10

LEGEND

- AREA TO BE KEPT CLEAR OF VEGETATION
- PROPOSED NEW ACCESS ROUTE
- PROPOSED IMPROVEMENTS TO EXISTING ACCESS ROUTE
- EXISTING ACCESS ROUTE
- $+^{4}$ STATIONING FOR PROFILES SHOWN ON PLATE "E-2"

NOTE:

1. Elevations shown on this sheet refer to Mean Sea Level.

GRAPHIC SCALE

1"=100' 100' 0 100' 200'

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY.

DR. BY.

CK. BY.

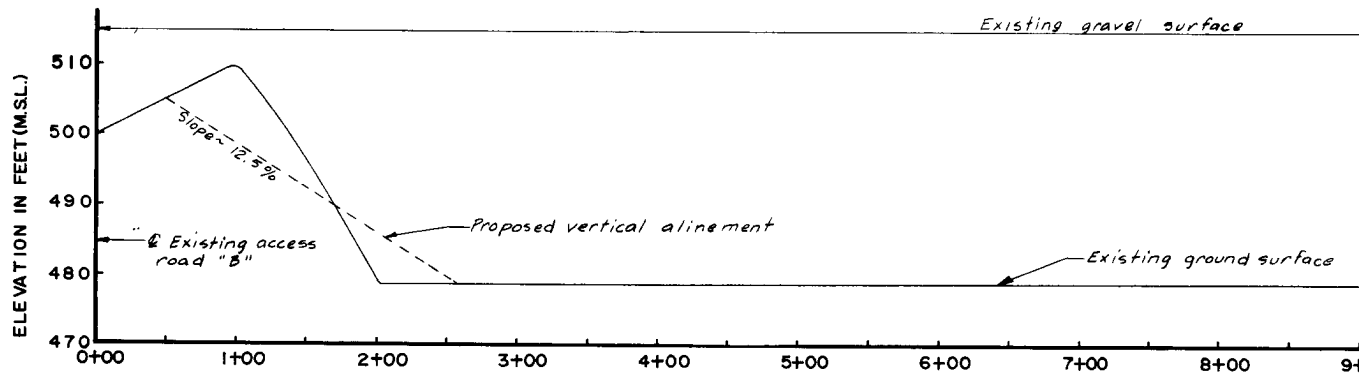
EMERGENCY ACCESS STUDY
UPPER CONNECTICUT RIVER BASIN

TOWNSHEND LAKE

GENERAL PLAN

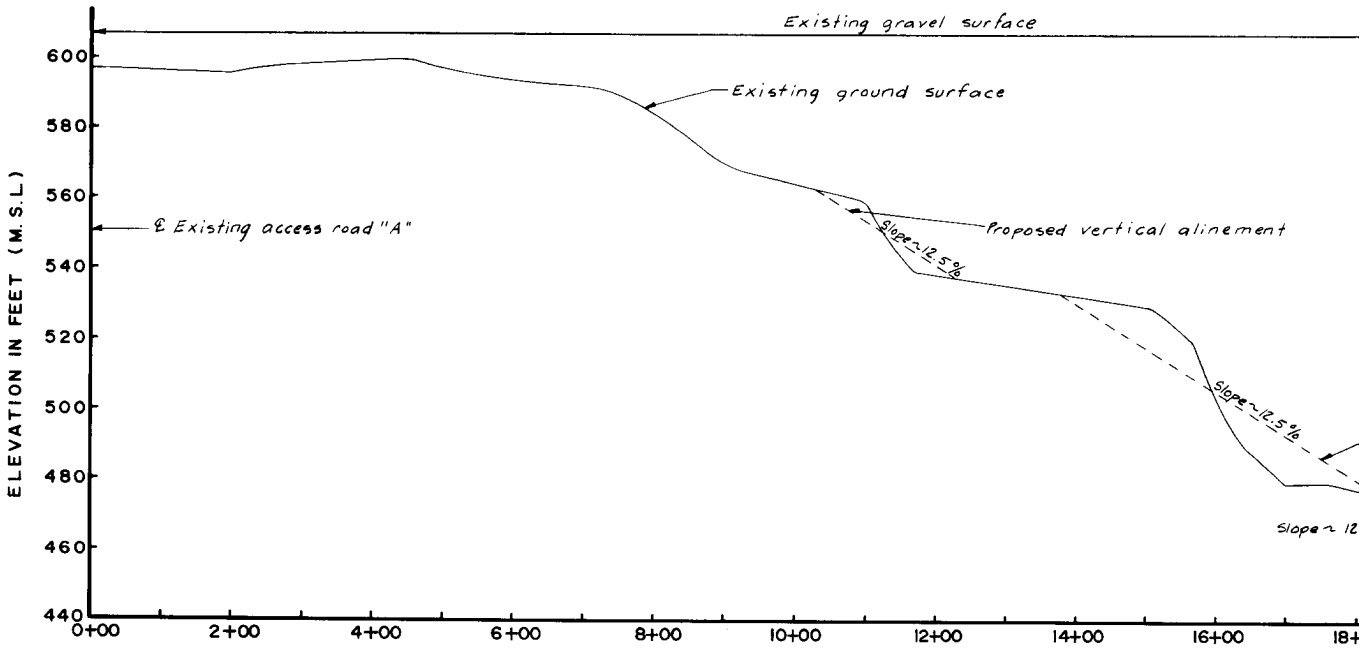
GEOTECH. ENG. DIV.
PLATE E-1

SCALE: AS SHOWN
DATE: SEPT. 1990



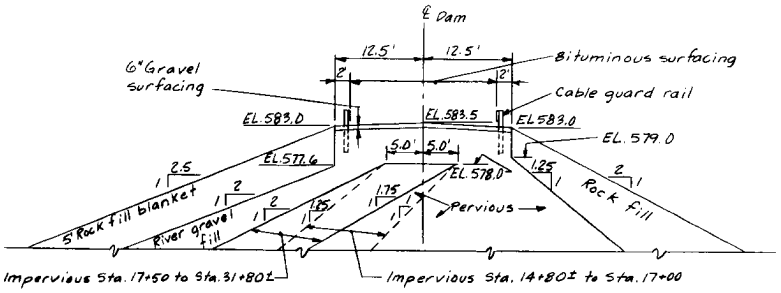
PROPOSED IMPROVEMENTS TO ACCESS ROAD "C"

SCALES: HOR. 1" = 50'
VERT. 1" = 10'



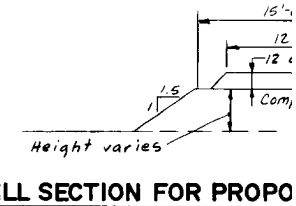
PROPOSED IMPROVEMENTS TO ACCESS ROAD "D" PROFI

SCALES: HOR. 1" = 100'
VERT. 1" = 20'

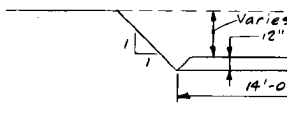


TYPICAL SECTION ACCESS ROAD "A"

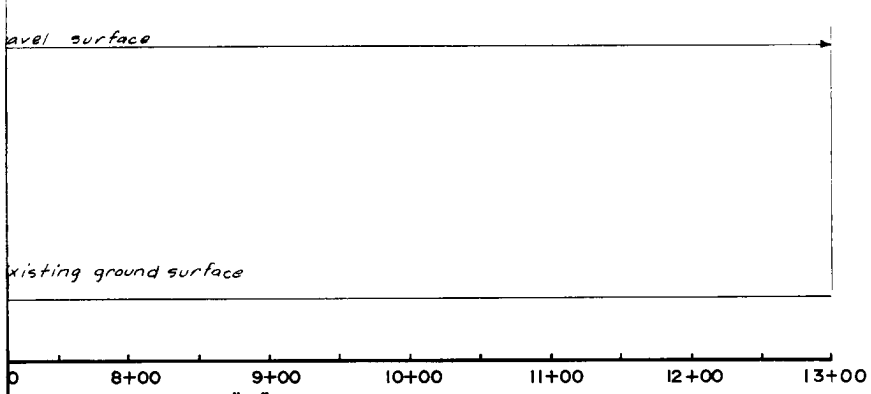
SCALE: 1" = 10'



TYPICAL FILL SECTION FOR PROPO

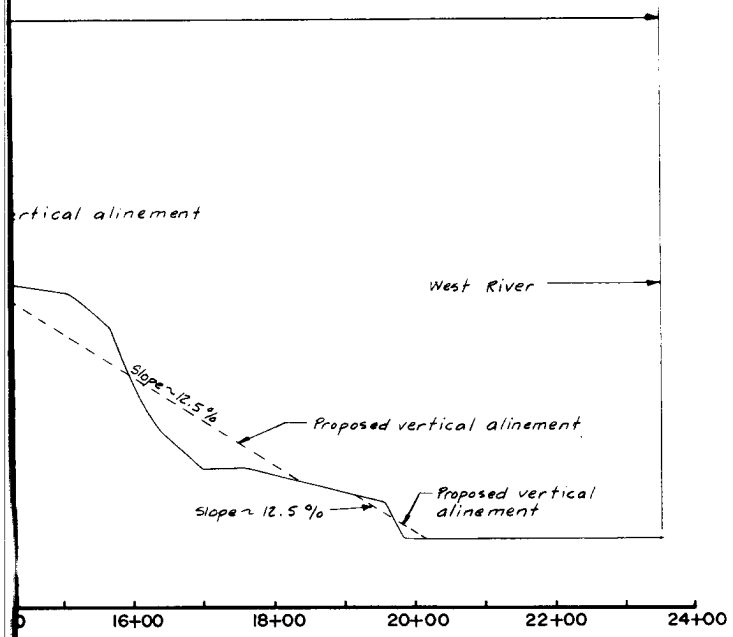


TYPICAL CUT SECTION FOR PROPO

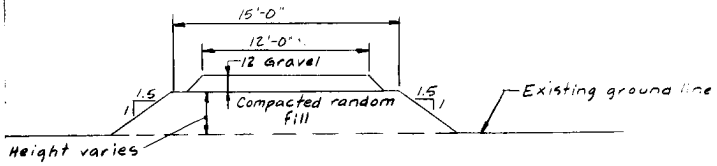


ACCESS ROAD "C"

50'
0'

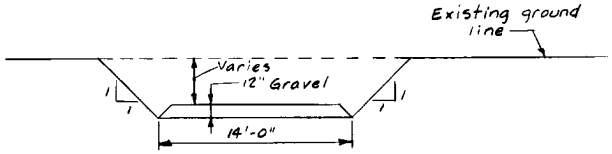


ROAD "D" PROFILE



SECTION FOR PROPOSED IMPROVEMENTS TO ACCESS ROADS "C" AND "D"

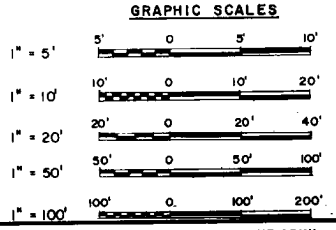
SCALE: 1" = 5'



SECTION FOR PROPOSED IMPROVEMENTS TO ACCESS ROADS "C" AND "D"

SCALE: 1" = 5'

GRAPHIC SCALES



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TOWNSHEND LAKE
PROFILES AND SECTIONS

GEOTECH. ENG. DIV.
PLATE E-2

SCALE: AS SHOWN
DATE: SEPT. 1990

APPENDIX F

SURRY MOUNTAIN LAKE

APPENDIX F
SURRY MOUNTAIN LAKE

TABLE OF CONTENTS

Paragraph No.	Subject	Page No.
	A. Pertinent Data	
1.	Pertinent Data	F-1
	B. Access to Downstream Toe	
2.	Existing Access	F-2
3.	Adequacy of Access	F-2
4.	Recommended Improvements	F-2
	C. Access to Crest of Dam	
5.	Existing Access	F-2
6.	Adequacy of Access	F-2
7.	Recommended Improvements	F-2
	D. Access to Outlet Works	
8.	Existing Access	F-3
9.	Adequacy of Access	F-3
10.	Recommended Improvements	F-3
	E. Access to Spillway - Channel and Weir	
11.	Existing Access	F-3
12.	Adequacy of Access	F-3
13.	Recommended Improvements	F-3
	F. Cost Estimates	
14.	Cost Estimates	F-4

LIST OF PLATES

Plate No.	Title
F-1	Surry Mountain Lake - General Plan
F-2	Surry Mountain Lake - Profile and Sections

APPENDIX F

SURRY MOUNTAIN LAKE

A. PERTINENT DATA

1. Pertinent Data.

LOCATION: The dam is in the Ashuelot River, 34.6 miles above the river's confluence with the Connecticut River and five miles north of Keene, New Hampshire. The project lies within the towns of Surry and Gilsum, Cheshire County, New Hampshire.

CONSTRUCTION PERIOD: August 1939 to October 1941

PURPOSE: The reservoir is operated as a unit of a coordinated system of reservoirs for flood control in the Connecticut River Basin. Although not specifically authorized, recreational facilities are provided.

RESERVOIR:

Drainage Area: 100 square miles

Operating Levels:

Pool	Elevation (ft, NGVD)	Area (acres)	Cumulative Capacity (acre-ft)
Inlet	485.0	0	0
Recreation	500.0	260	1,320
Flood Control (Spillway Crest)	550.0	970	33,000

DAM:

Type: Rolled earth fill, rock slope protection, impervious core

Maximum Height (ft): 86

Length (ft): 1,800

Top Elevation (ft, NGVD): 568.0

SPILLWAY:

Location: Right abutment

Type: Uncontrolled ogee weir, L-shaped side channel spillway

Crest Length (ft): 338

Crest Elevation (ft, NGVD): 550.0

Maximum Discharge Capacity (cfs): 50,000

OUTLET WORKS:

Type:	Boston Horseshoe
Size:	10' diameter
Length (ft):	383
Gates:	(2) Service 4'-6" x 10'-0" Broome
Discharge at Spillway Crest (cfs):	3,700
Stilling Basin:	None

B. ACCESS TO DOWNSTREAM TOE

2. Existing Access. The downstream toe of Surry Mountain Dam can be reached by travelling across the crest of the dam (Access Road "A"), down the east abutment of the dam (Access road "B") and across the downstream toe of the dam (Access Road "C"). Access Road "A" is a 30 foot wide bituminous concrete road which is in good condition. Access Road "B" is a 10 to 20 foot wide gravel road. Project staff upgraded Access Road "B" during the summer of 1991. They installed new culverts, improved the drainage channels, removed brush and added gravel so it could be used more safely during adverse weather. Access Road "C" is a fairly flat grass area which is flooded with four to five feet of water when spillway discharge occurs.

3. Adequacy of Access. The downstream toe of Surry Mountain Dam can not be traversed when spillway discharge occurs.

4. Recommended Improvements. The surface of Access Road "C" should be raised above the elevation of water which inundates the area during spillway discharge. It is recommended that an approximately seven foot high stone berm be constructed adjacent to the dam embankment as shown on Plates F-1 and F-2. Three inches of crushed stone should be placed on the stone berm so that maintenance vehicles can travel on top of it.

C. ACCESS TO CREST OF DAM

5. Existing Access. A 30 foot wide bituminous concrete surfaced road (Access Road "A") crosses the crest of Surry Mountain Dam. The spillway bridge connects the west end of Access Road "A" and the north end of local road which extends southerly to New Hampshire State Route 12A. The local road has bituminous concrete surface and is in fair to good condition. The spillway bridge has a concrete deck which has a 12 foot wide travel surface.

Presently there are no access roads to the upstream toe of the dam.

6. Adequacy of Access. Access to the crest of Surry Mountain Dam is adequate. The upstream toe of the dam can only be reached by foot or boat.

7. Recommended Improvements. Access Road "F" as shown on Plate F-1 and F-2 is recommended to improve access to the upstream toe of Surry Mountain Dam. It would be a rock fill road which would provide upstream toe access during

normal pool conditions. The surface of Access Road "D" should be surfaced with six inches of gravel so that heavy equipment can easily reach Access Road "F" from Access Road "A".

D. ACCESS TO OUTLET WORKS

8. Existing Access. The intake channel and structure can be reached using Access Road "E". Access Road "E" is a 12 foot wide gravel road which originates approximately 700 feet north of the inlet structure in Surry Mountain Camp Ground. A bituminous concrete road in very good condition connects the Surry Mountain Camp Ground and New Hampshire State Route 12A. Access Road "E" could be used until the pool reaches elevation 545 feet NGVD. Some clearing and gravel to bridge soft areas would be required if heavy equipment was to use Access Road "E".

The outlet channel and structure can be reached by traveling down Access Road "B" to Access road "C". Access Roads "B" and "C" are discussed in paragraph 2.

9. Adequacy of Access. Access Road "E" is adequate to access the inlet channel and structure until the pool reaches an elevation five feet below spillway discharge (545 feet NGVD). Access Road "C" is inadequate during spillway discharge because it is inundated by four to five feet of water.

10. Recommended Improvements. Clearing and placement of a small amount of gravel (approximately 100 cubic yards) should be done along Access Road "E" so that heavy equipment can use it easier. Access Road "C" should be improved as discussed in paragraph 4.

E. ACCESS TO SPILLWAY - CHANNEL AND WEIR

11. Existing Access. The same access roads which service the outlet works also service the spillway channel and weir. They are discussed in paragraph 8. They provide access from the east side of the spillway channel and weir. Providing access from the west side of the spillway channel and weir is beyond the scope of this study.

12. Adequacy of Access. Similar to paragraph 9 for the outlet works.

13. Recommended Improvements. Same as paragraph 10 for the outlet works.

F. COST ESTIMATES

14. Cost Estimates.

Improvement to Access Road "C"

Item	Qty	Unit	Unit Price ($)	Cost ($)
Mob-demob	1	Job	LS	5,000
Excavation	500	CY	6.00	3,000
Gravel	200	CY	15.00	3,000
Rock Fill	3,000	CY	40.00	120,000
Random Fill	50	CY	8.00	400
Crushed Stone	100	CY	25.00	2,500
Subtotal				133,900
Contingency 20%				26,780
TOTAL				160,680
SAY				$160,000

Improvement to Access Road "D"

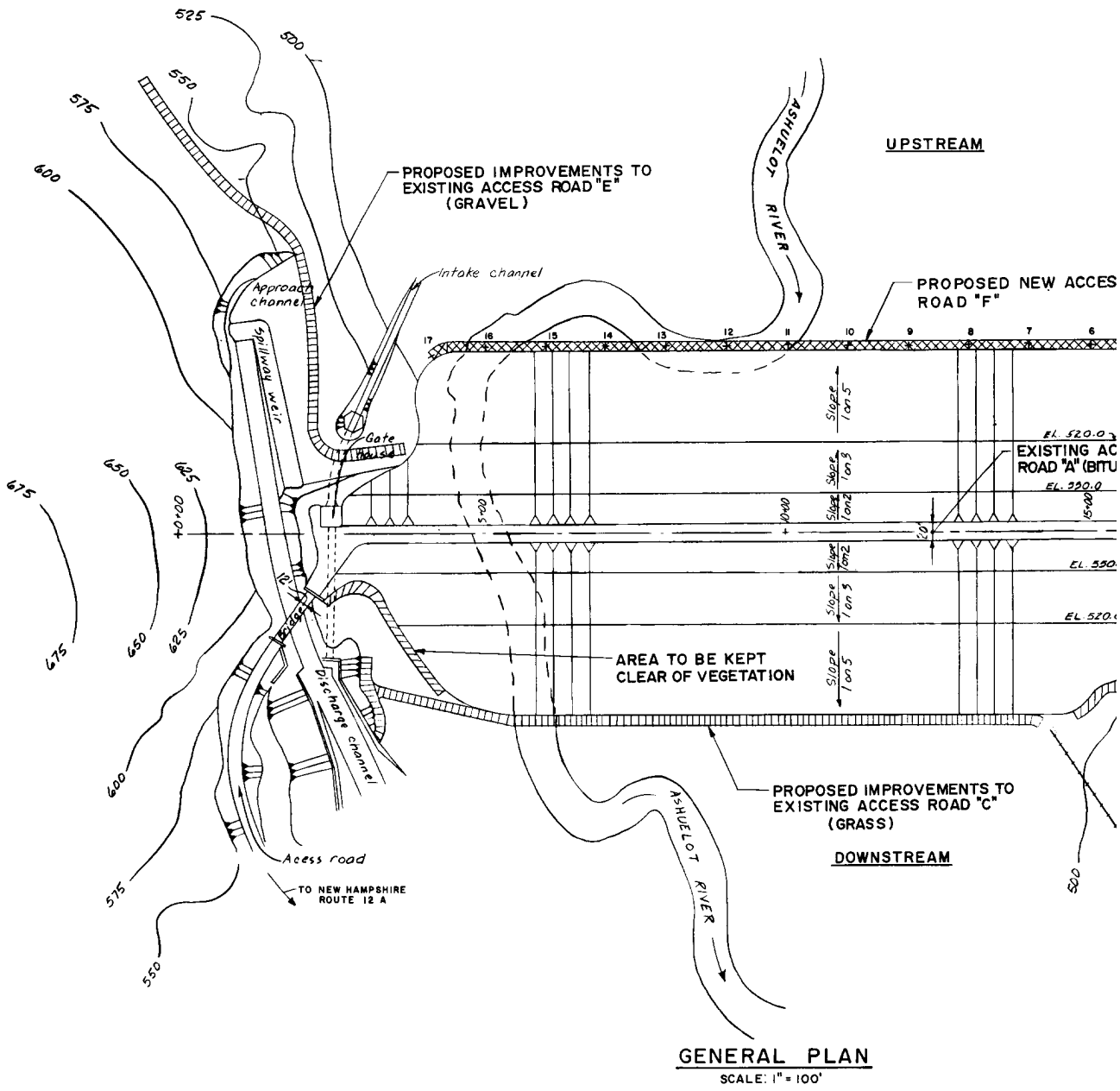
Item	Qty	Unit	Unit Price ($)	Cost ($)
Mob-demob	1	Job	LS	2,000
Clearing	1	Job	LS	1,000
Gravel Fill	100	CY	15.00	1,500
Subtotal				4,500
Contingency 20%				900
TOTAL				5,400
SAY				$5,000

Improvement to Access Road "E"

Item	Qty	Unit	Unit Price ($)	Cost ($)
Mob-demob	1	Job	LS	2,000
Clearing	1	Job	LS	1,000
Gravel Fill	100	CY	15.00	1,500
Subtotal				4,500
Contingency 20%				900
TOTAL				5,400
SAY				$5,000

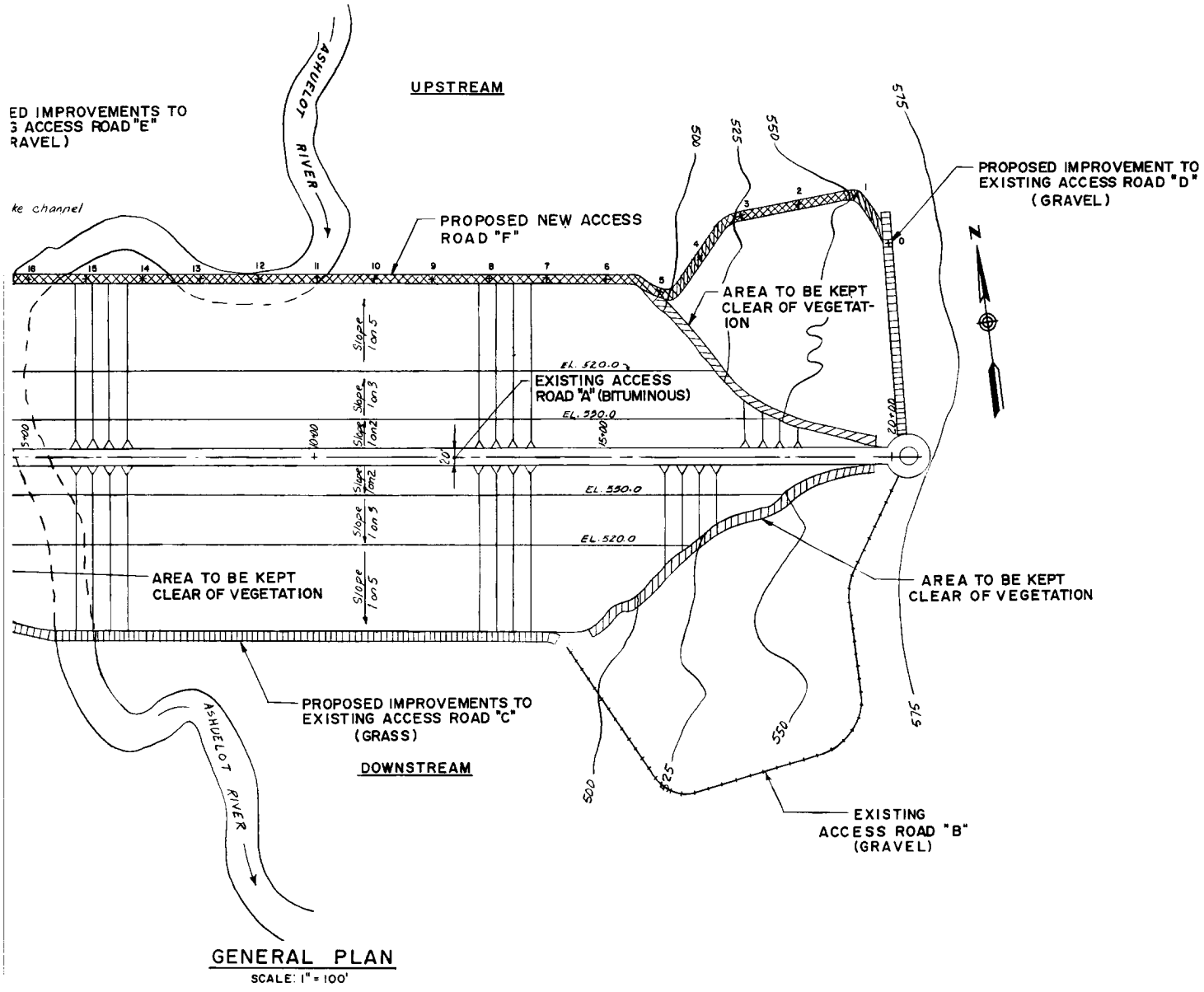
Improvement to Access Road "F"

Item	Qty	Unit	Unit Price ($)	Cost ($)
Mob-demob	1	Job	LS	5,000
Clearing	1	Job	LS	4,000
Excavation	250	CY	6.00	1,500
Gravel Fill	250	CY	15.00	3,750
Rock Fill	3,000	CY	40.00	120,000
Crushed Stone	120	CY	25.00	3,000
Random Fill	50	CY	8.00	400
Subtotal				137,650
Contingency 20%				27,530
TOTAL				165,180
SAY				$170,000



GENERAL PLAN

SCALE: 1" = 100'



GENERAL PLAN

SCALE: 1" = 100'

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GRAPHIC SCALE

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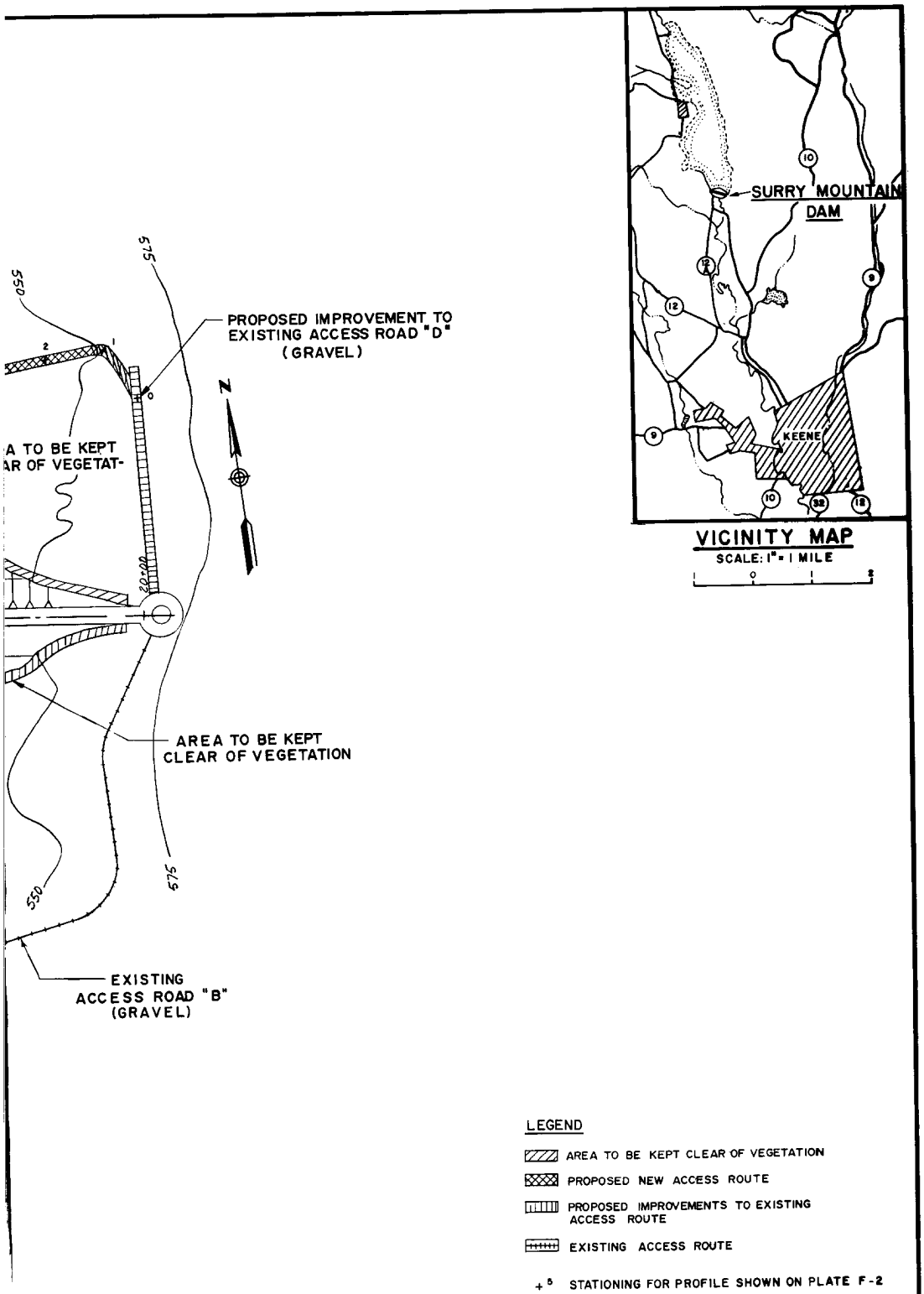
PLATE F-1



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SURRY MOUNTAIN LAKE
GENERAL PLAN

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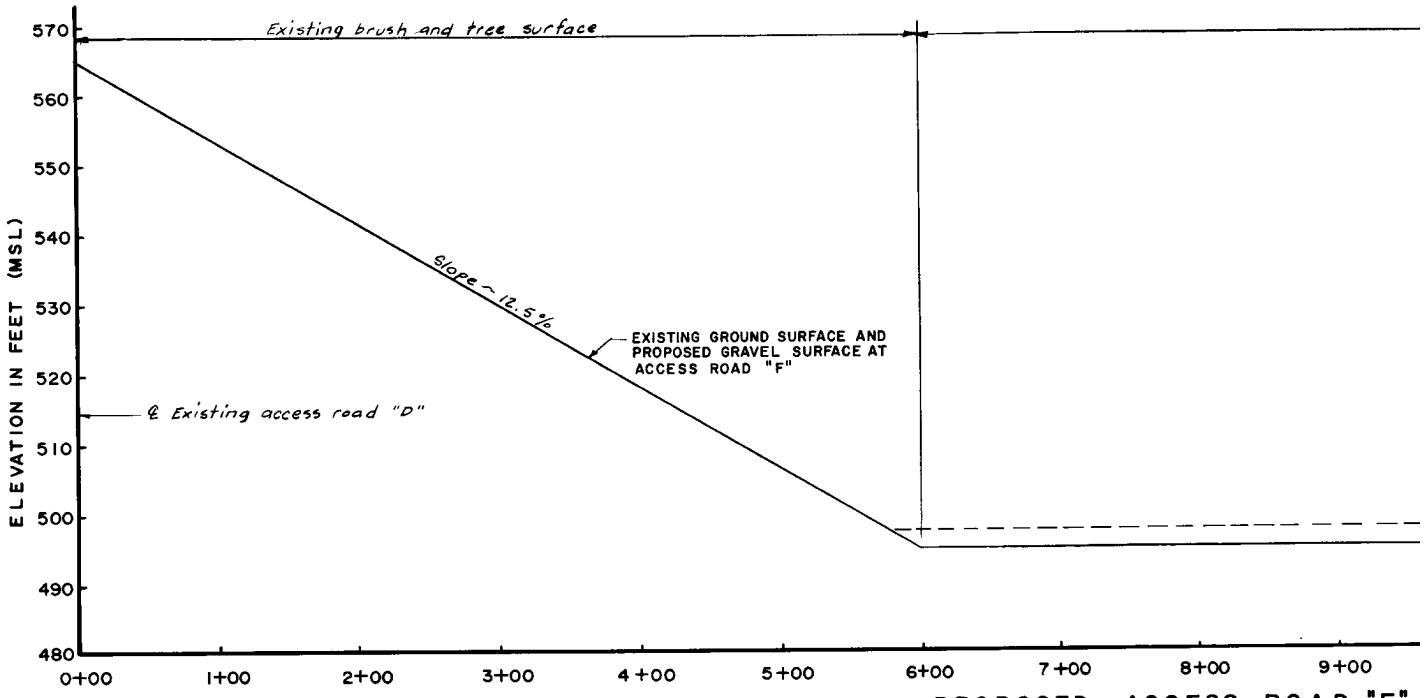
DR. BY.
CK. BY.

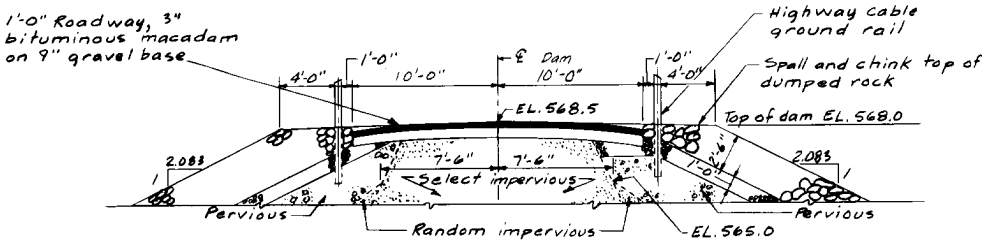
GEOTECH. ENG. DIV.
PLATE F-1

SCALE: 1" = 100'
DATE: AUG. 1990



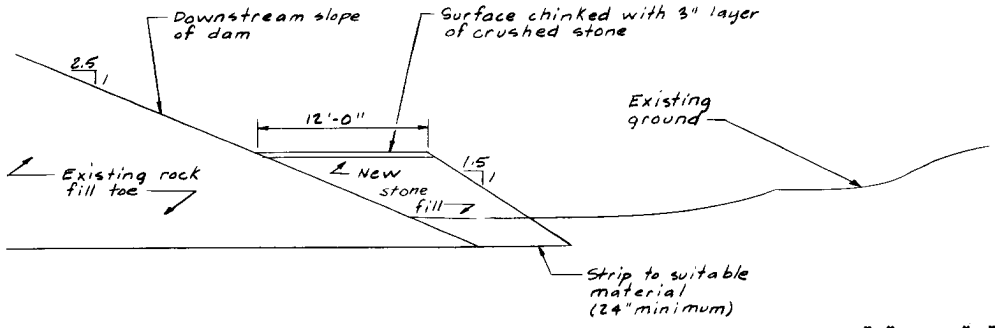
PROPOSED ACCESS ROAD "F"

SCALES: HORZ: 1" = 50'
VERT: 1" = 10'



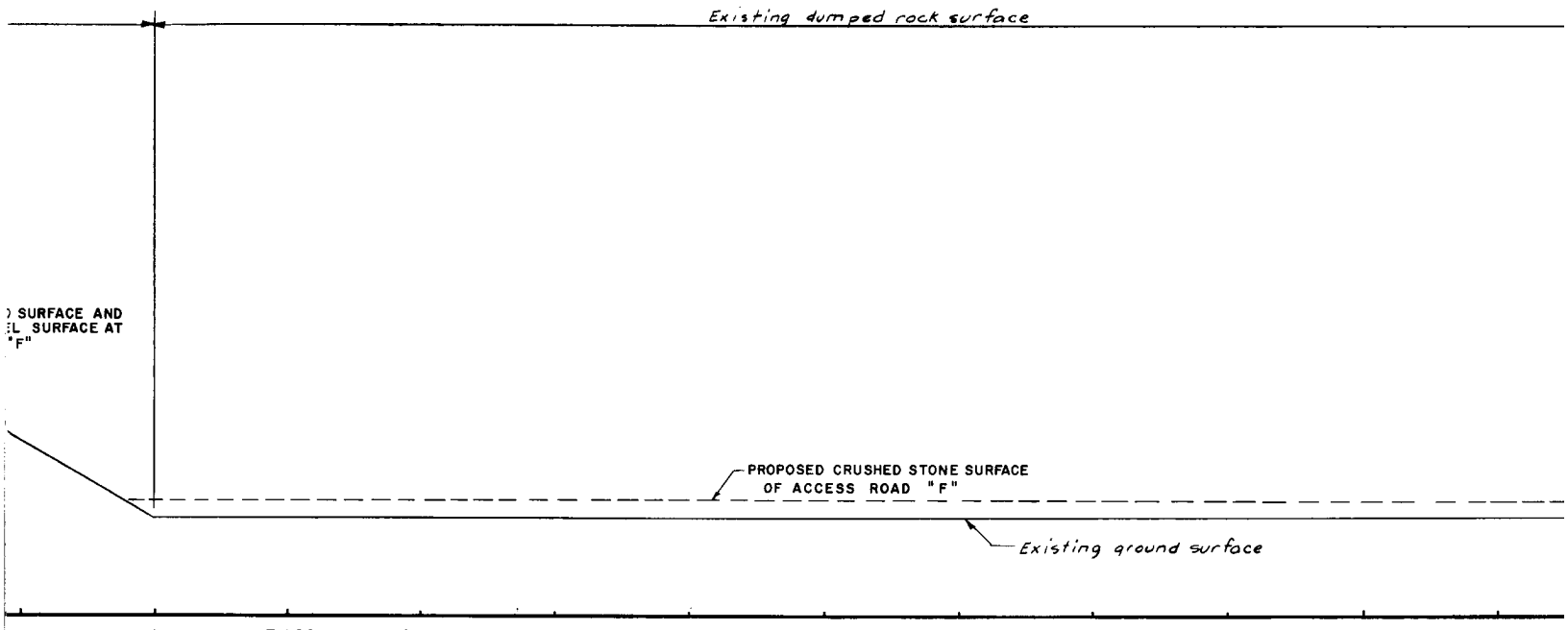
TYPICAL SECTION FOR ACCESS ROAD "A"

SCALE: 1"=5'



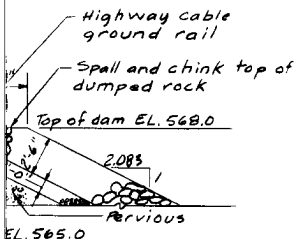
TYPICAL ROCK FILL SECTION FOR PROPOSED ACCESS ROADS "C" AND "F"

SCALE: 1" = 5'



PROPOSED ACCESS ROAD "F"

SCALES: HORZ. 1" = 50'
VERT. 1" = 10'



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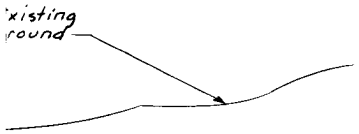

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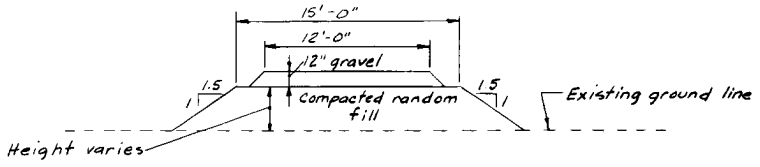
ED ACCESS ROADS "C" AND "F"



TYPICAL FILL SECTION FOR PROPOSED ACCESS ROADS "C"

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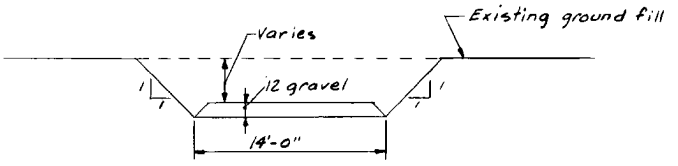

TYPICAL CUT SECTION FOR PROPOSED ACCESS ROADS "C" AND "F"

SCALE: 1" = 5'

GRAPHIC SCALES

1" = 5'	5'	0	5'	10'
1" = 10'	10'	0	10'	20'
1" = 50'	50'	0	50'	100'

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PLATE F-2

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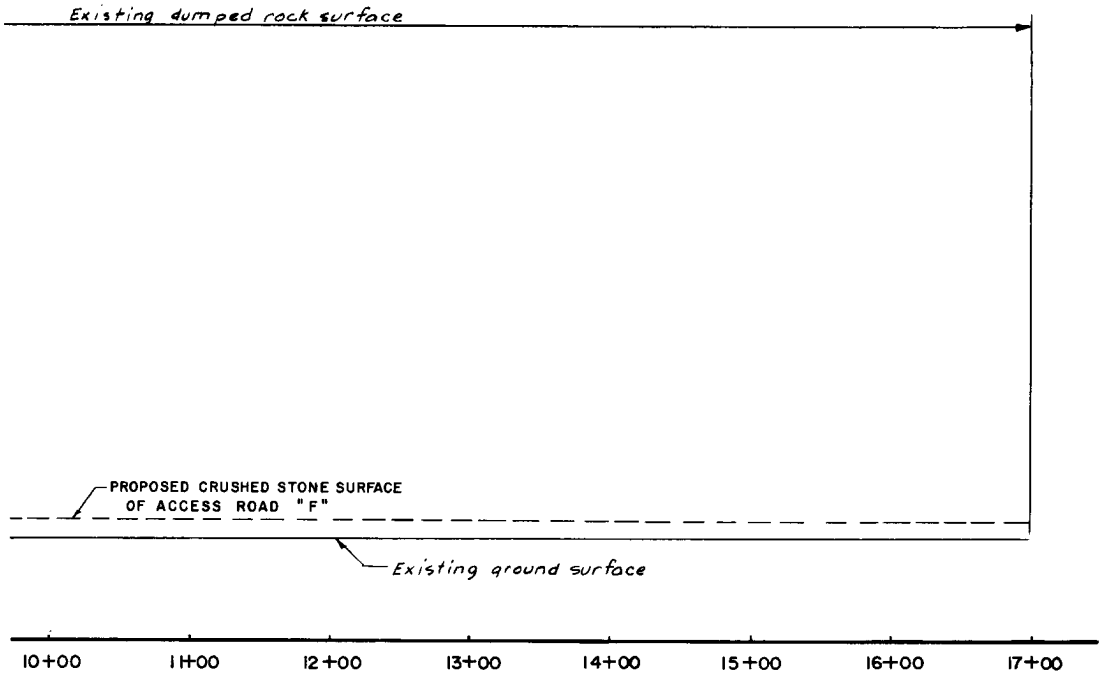
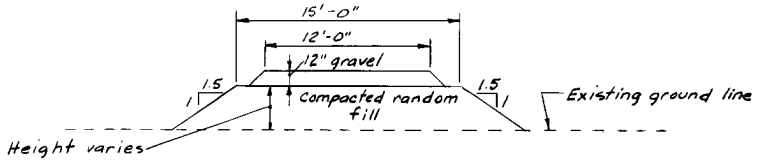
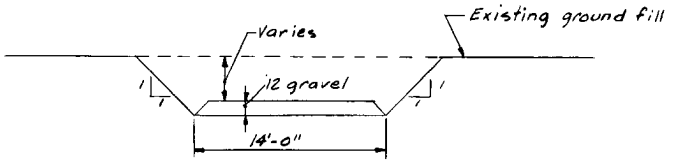




TYPICAL FILL SECTION FOR PROPOSED ACCESS ROADS "C"

SCALE: 1" = 5'



TYPICAL CUT SECTION FOR PROPOSED ACCESS ROADS "C" AND "F"

SCALE: 1" = 5'

GRAPHIC SCALES

1" = 5'	5'	0	5'	10'	
1" = 10'	10'	0	10'	20'	
1" = 50'	50'	0	50'	100'	

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SURRY MOUNTAIN LAKE
PROFILE AND SECTIONS

GEOTECH. ENG. DIV.
PLATE F - 2

SCALE: AS SHOWN
DATE: AUG. 1990

APPENDIX G

OTTER BROOK LAKE

APPENDIX G
OTTER BROOK LAKE

TABLE OF CONTENTS

Paragraph No.	Subject	Page No.
	A. Pertinent Data	
1.	Pertinent Data	G-1
	B. Access to Downstream Toe	
2.	Existing Access	G-2
3.	Adequacy of Access	G-2
4.	Recommended Improvements	G-2
	C. Access to Crest of Dam	
5.	Existing Access	G-2
6.	Adequacy of Access	G-3
7.	Recommended Improvements	G-3
	D. Access to Outlet Works	
8.	Existing Access	G-3
9.	Adequacy of Access	G-3
10.	Recommended Improvements	G-3
	E. Access to Spillway - Channel and Weir	
11.	Existing Access	G-3
12.	Adequacy of Access	G-3
13.	Recommended Improvements	G-3
	F. Cost Estimates	
14.	Cost Estimates	G-4

LIST OF PLATES

Plate No.	Title
G-1	Otter Brook Lake - Plan and Sections

APPENDIX G

OTTER BROOK LAKE

A. PERTINENT DATA

1. Pertinent Data.

LOCATION: The dam is on Otter Brook, 2.4 miles upstream from the brook's confluence with The Branch which flows 2.5 miles to the Ashuelot River at Keene, New Hampshire. The reservoir lies within the town of Keene, Cheshire County, New Hampshire.

CONSTRUCTION PERIOD: September 1956 to August 1958

PURPOSE: The reservoir is operated as a unit of a coordinated system of reservoirs for flood control in the Connecticut River Basin. Although not specifically authorized, recreational facilities are provided.

RESERVOIR:

Drainage Area: 47.2 square miles

Pool	Elevation (ft, NGVD)	Area (acres)	Cumulative Capacity (acre-ft)
Inlet	683.0	12	0
Recreation	701.0	70	720
Flood Control (Spillway Crest)	781.0	374	18,320

DAM:

Type:	Rolled earth fill, rock slope protection, impervious core
Maximum Height (ft):	133
Length (ft):	1,288
Top Elevation (ft, NGVD):	802.0

SPILLWAY:

Location:	Right abutment
Type:	Uncontrolled ogee weir, chute spillway
Crest Length (ft):	145
Crest Elevation (ft, NGVD):	781.0
Maximum Discharge Capacity (cfs):	40,000

OUTLET WORKS:

Type:	Boston Horseshoe
Size:	6' diameter
Length (ft):	589
Gates:	(3) Service 2'-6" x 4'-6" hydraulic slide
Discharge at Spillway Crest (cfs):	1,320
Stilling Basin:	25' width x 35' length w/baffles and 4' end sill

B. ACCESS TO DOWNSTREAM TOE

2. Existing Access. The downstream toe of Otter Brook Dam is a relatively flat grass area that has steep abutment slopes. It can be reached by travelling northeast on Access Road "B" from the East Access Road (Davis Road). Access Road "B" turns to the west along the dam toe and then turns again to northeast and ends at the west crest of the dam. It is an 18-foot wide bituminous concrete road which is in very good condition. Heavy equipment would have no problems using Access Road "B" to reach the downstream toe of Otter Brook Dam. The downstream abutments of the dam can only be reached by foot and possibly lightweight equipment.

3. Adequacy of Access. Access to the downstream toe of Otter Brook Dam is considered adequate.

4. Recommended Improvements. Vegetation should periodically removed from the abutment interfaces of Otter Brook Dam, as has been done in the past.

C. ACCESS TO CREST OF DAM

5. Existing Access. A 20-foot wide bituminous concrete road (Access Road "A") extends along the crest of Otter Brook Dam. Access Road "A" is in very good condition. It enters the rotary at the west end of the dam and intersects with the east access road (Davis Road) at the east end of the dam. The East Access Road is a two lane road with a bituminous concrete surface. It is in fair to good condition. It connects with New Hampshire State Route 101 to the south (approximately two miles) and New Hampshire State Route 9 to the north (approximately four miles).

The recreational pool (elevation 701 feet NGVD) normally inundates the upstream toe of Otter Brook Dam. The west end of the toe area can be reached by descending from the rotary at the west end of the dam on Access Road "C". Access Road "C" is a 12-foot wide bituminous and gravel road. The bituminous concrete stops approximately 165 feet from the intake tower. It is in good condition but it has a steeper than 12.5 percent grade. However, there is no means, even if the pool was drawn down, to travel across the toe from the downstream end of Access Road "C".

6. Adequacy of Access. Access to the crest of Otter Brook Dam is considered adequate. Access to the upstream toe could be improved by constructing a road across the upstream stone slope of the dam.

7. Recommended Improvements. Access Road "E" should be constructed as shown on Plate G-1 to improve access to the upstream toe of Otter Brook Dam. It would be a rock fill road which would provide access at recreational pool level (elevation 701 feet NGVD) or lower. Vegetation should be removed periodically from the east upstream abutment.

D. ACCESS TO OUTLET WORKS

8. Existing Access. The inlet channel and structure can easily reached from Access Road "C", as discussed in paragraph 5. The outlet channel and structure can easily be reached using Access Road "B", as discussed in paragraph 2.

9. Adequacy of Access. Access Roads "B" and "C" provide adequate access to the Outlet Works at Otter Brook Dam.

10. Recommended Improvements. No improvements to existing access roads or additional access roads to the outlet works are recommended.

E. ACCESS TO SPILLWAY - CHANNEL AND WEIR

11. Existing Access. Access Roads "B" and "D" provide access to the spillway channel and weir. Access Road "B" extends roughly parallel to the channel from the rotary at the dam crest to the base of the dam, as described in paragraph 2. Heavy equipment would have to travel across grass areas short distances (200 feet or less) to reach the discharge channel from Access Road "B". Access Road "D" is a 12-foot wide gravel road which extends westerly from Access Road "B" at the base of the dam to the discharge channel. Heavy equipment could travel along Access Road "D" and then up the floor of the discharge channel to the weir.

12. Adequacy of Access. Access to the spillway channel and weir is considered adequate at Otter Brook Dam.

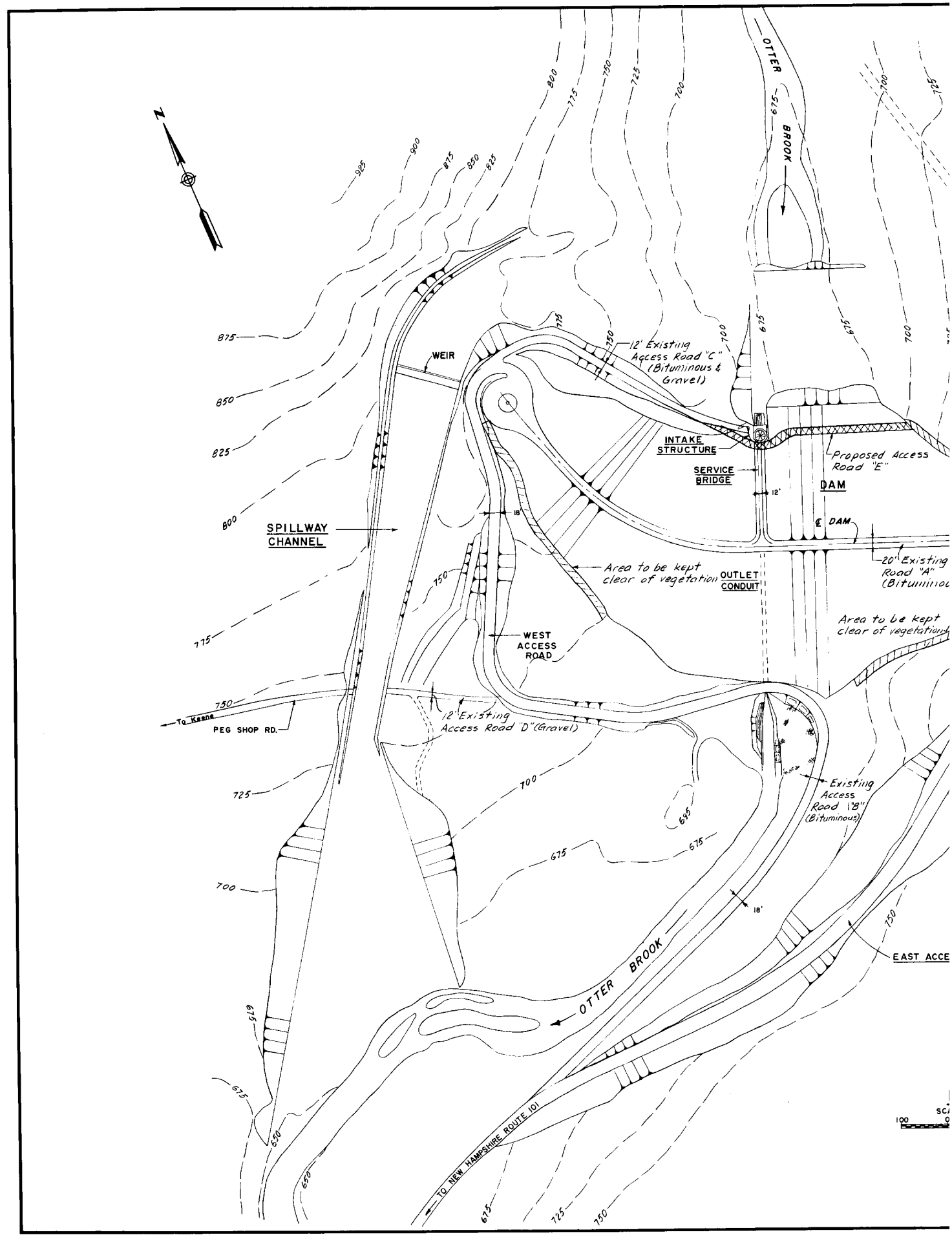
13. Recommended Improvements. No improvement to existing access roads or additional access roads to the spillway channel and weir are recommended. A small amount (probably less than 50 cubic yards) of gravel may be required to work on the grass area between Access Road "B" and the spillway channel during heavy rain storms.

F. COST ESTIMATES

14. Cost Estimates.

Improvement to Access Road "E"

Item	Qty	Unit	Unit Price ($)	Cost ($)
Mob-demob	1	Job	LS	5,000
Rock Fill	1,200	CY	40.00	48,000
Crushed Stone	50	CY	25.00	1,250
Subtotal				54,250
Contingency 20%				10,850
TOTAL				65,100
SAY				$65,000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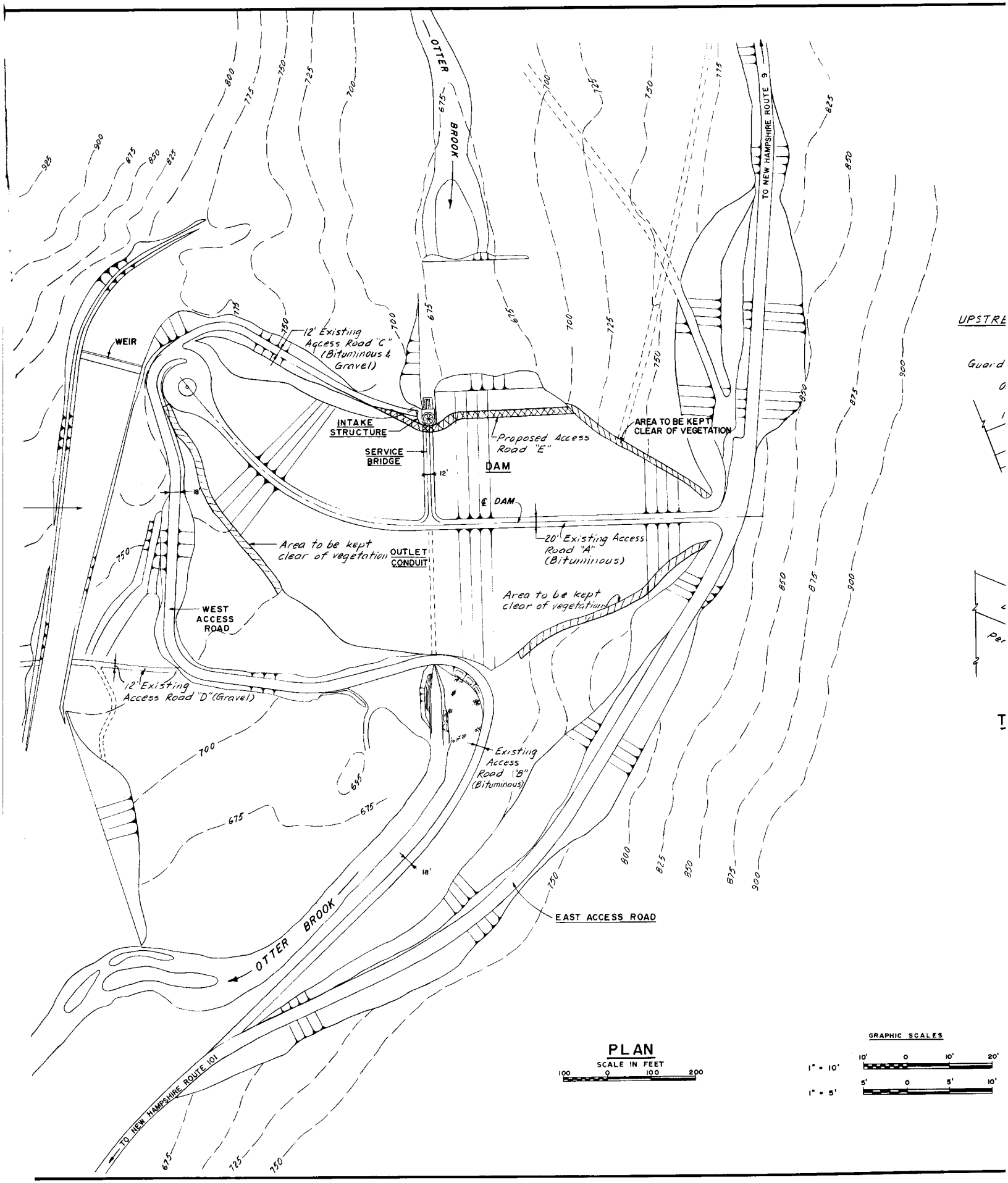
OTTER BROOK
WEIR
12' Existing Access Road "C" (Bituminous & Gravel)
INTAKE STRUCTURE
SERVICE BRIDGE
Proposed Access Road "E"
DAM
℄ DAM
SPILLWAY CHANNEL
Area to be kept clear of vegetation
OUTLET CONDUIT
20' Existing Road "A" (Bituminou
Area to be kept clear of vegetation
WEST ACCESS ROAD
To Keene
PEG SHOP RD.
12' Existing Access Road "D" (Gravel)
Existing Access Road "B" (Bituminous)
OTTER BROOK
TO NEW HAMPSHIRE ROUTE 101
EAST ACCE
18'
12'
875
850
825
800
775
750
725
700
675
650
625
600
900
925



PLAN

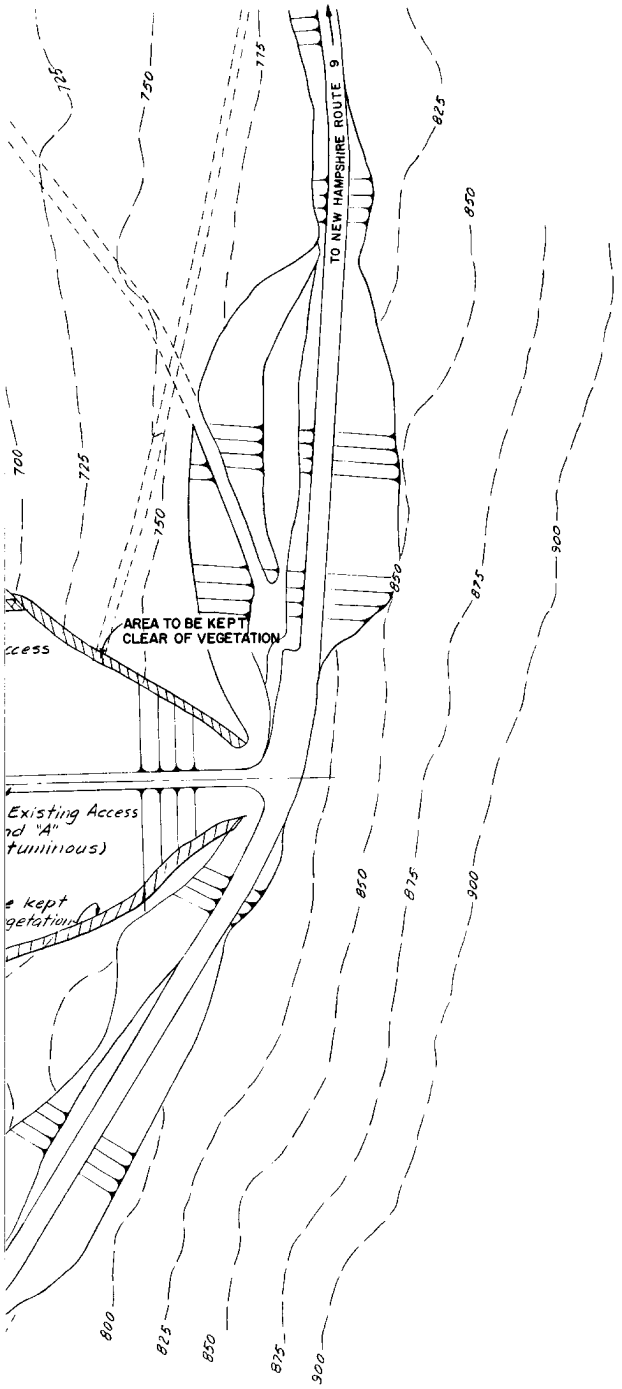
SCALE IN FEET

100 0 100 200

GRAPHIC SCALES

1" = 10' 10' 0 10' 20'

1" = 5' 5' 0 5' 10'

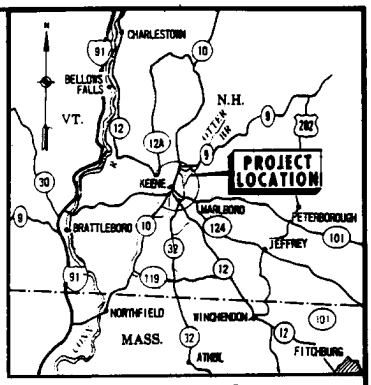


AST ACCESS ROAD

PLAN

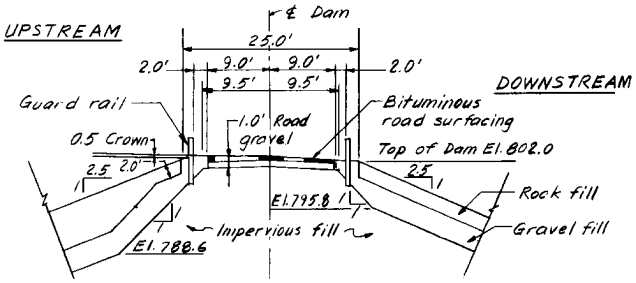
SCALE IN FEET

20 0 100 200



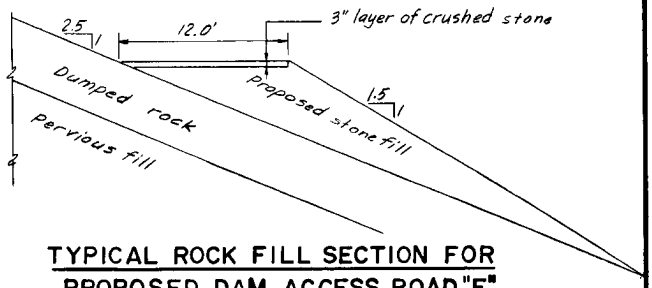
VICINITY MAP

SCALE IN MILES



TYPICAL SECTION FOR EXISTING ACCESS ROAD "A"

SCALE: 1" = 10'



TYPICAL ROCK FILL SECTION FOR PROPOSED DAM ACCESS ROAD "E"

SCALE: 1" = 5'

LEGEND

- AREA TO BE KEPT CLEAR OF VEGETATION
- PROPOSED NEW ACCESS ROUTE
- EXISTING ACCESS ROUTE

GRAPHIC SCALES

1" = 10' 10' 0 10' 20'

1" = 5' 5' 0 5' 10'

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

EMERGENCY ACCESS STUDY

UPPER CONNECTICUT RIVER BASIN

OTTER BROOK LAKE

PLAN AND SECTIONS

DES. BY:

DR. BY: A.W.C.

CK. BY:

GEOTECH. ENG. DIV.
PLATE G-1

SCALE: 1" = 100'

DATE: AUG. 1990

APPENDIX H

TRIP REPORT

DISPOSITION FORM

For use of this form, see AR 340-15, the proponent agency is TAGO.

RI	ENCE OR OFFICE SYMBOL	SUBJECT
	DAEN-ECE-B	Trip Report - NED Office Visit and Dam Site Inspections (22-25 October 1984)

TO	FROM	DATE	CMT 1
DAEN-ECE-B ECE-G ECE	DAEN-ECE-B/G	5 November 1984 BROWN/WALZ/HART/gg/20234	

1. Purpose. To discuss design efforts for remedial measures being accomplished for North Springfield, Thomaston, and Townshend dams in Vermont. Also to investigate the work being done at North Hartland and Deweys Mills Dams regarding the installation of non-Federal hydropower.

2. Attendance. Those in attendance at the office meeting were as follows:

Charlie Tiersch (NED)
Toni Mancini (NED)
Tim Boshman (NED)
John Hart (NED)
Richard Reardon (Part Time) (NED)
Art Walz (DAEN-ECE-G)
Pete Hart (DAEN-ECE-G)
Philip Brown (DAEN-ECE-B)

3. Narrative. Five dam sites were visited and a discussion of each follows:

a. Townshend Dam. This project is located on the West River in Vermont. It utilized about 67 percent of its storage capacity during high rainfall in May 1984. A head of 78 feet was created which resulted in seepage from the foundation (2.5 cfs) and a quick condition in an area at the junction of the downstream toe and right abutment. Remedial work was accomplished in this same area in 1970 to correct a seepage condition from a high pool in April 1969. The Division plans to install additional instrumentation, relief wells with a discharge below ground surface, and extend the filter placed in 1970. These measures are considered appropriate.

b. North Springfield Dam. This project is located on the Black River in Vermont. It utilized 67 percent of its storage in May 1984 which created a head of 75 feet at the downstream toe. Seepage from the terrace on the right abutment at the junction with the embankment measured about 2.0 cfs, became cloudy, and some piping occurred. Remedial measures were constructed in this area in 1970 as a result of previous seepage. The Division plans exploration, additional instrumentation and an extension of the downstream filter on the right abutment terrace. This is considered appropriate.

c. North Hartland Dam. Non-Federal hydropower is being installed in the existing outlet works. The 16' ϕ pipe through the tunnel to the new downstream control structure, the bifurication area, and to the power house is complete. The contractor is currently working on the concrete power house with construction scheduled to be completed in May 1985.

1 Attachment

d. Dewey's Mills Dam. This dam is in the North Hartland pool acquired by the Corps when North Hartland Dam was constructed. A non-Federal hydropower unit is currently being installed by Hydro Energies Corporation (HEC) of Boston. Upstream and downstream cofferdams have been constructed diverting flow around the area where the powerhouse will go. Blasting for the powerhouse and outlet channel is completed. The contractor was working on the powerhouse foundation when we were there. Construction is scheduled to be completed in FY 85.

e. Ball Mountain Dam. During the course of the trip an inspection was made of a small bulge in the downstream slope and differential settlements in the crest of Ball Mountain Dam on the West River in Vermont. Ball Mountain is an earth and rockfill dam located in a steep narrow valley, having a maximum height of 265 feet with 1V on 2.5H upstream slope and a very steep 1V on 1.75H downstream slope. The project was completed in November 1961 and to date there have been 3 periodic inspections (March 1975, July 1979, August 1984).

The bulge in the downstream slope extends over the entire length of the embankment. Settlement along the top of dam is on the order of 18-24 inches with all visible indications of a slide. In the center of the embankment the movement has occurred in an area along the downstream edge of the crown, which indicates a shallow surficial movement. In the reach adjacent to both abutments the scarp trace is present across the crown and into the upstream slope for several feet which is infringing upon the freebroad. In the past, surface monumentation has been hard to correlate. However, a comparison of photographs indicate that the upstream encroachment in the vicinity of the abutments has occurred between the 1979 and 1984 periodic inspections. It was also noted that the only access to the embankment was through the spillway approach channel.

The Division has a plan to monitor and evaluate the embankment movement in FY 85, by use of monuments and slope indicators. This program should be expanded to include sufficient slope indicators, test pits in the top of dam, exploration and sufficient monuments to locate and define the zone of movement and obtain sufficient data to start the necessary remedial measures.

4. Conclusions and Recommendations. Work should continue as outlined at the exit meeting on 25 October 1984. The following items are offered for appropriate action:

a. The design of the remedial measures for North Springfield, Townshend and Thomaston Dams is on track and should continue as planned. The program for instrumentation of these projects is considered appropriate and should continue as planned.

b. The evaluation of the Ball Mountain embankment should proceed on a timely schedule. Recommend the slope indicators be installed and read by contract while the remainder of the work be accomplished by in-house forces. Monuments should be installed immediately in order to obtain an adequate data base.

c. The dam operating plan for Ball Mountain should be reviewed in light of the embankment condition and limited access, and appropriate modifications initiated.

d. A review of all of the Divisions projects should be made to determine if access is available to all pertinent parts of the project during high reservoir conditions.

AHW
ART WALZ
DAEN-ECE-GS

for AHW
PETE HART
DAEN-ECE-GG

PHIL BROWN
DAEN-ECE-B